Trouble-shooting instructions : VWW-5008

BOSCH system : KE-Jetronic 2.5

Make of vehicle : NISSAN

Basic microcard : AUD-507

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SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle model:

NISSAN Santana 03.86->
with 2.0 l / 5-cylinder engine
80 kW (110 bhp)

* KE 2.5 - Jetronic
* Lambda closed-loop control
* Low-idle-speed control
* Overrun cut-off
* Injection valves with fixed air-guide cap. Connection of the tester for delivered quantity comparison with adapter sleeves KDJE-P 200/19.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to prevent damage to the engine, trigger boxes and control units or to the ignition system, be sure to observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

For testing the compression, disconnect the pump relay in order to prevent undesired injection by the injection valves.

Important information with regard to working on the KE Jetronic.

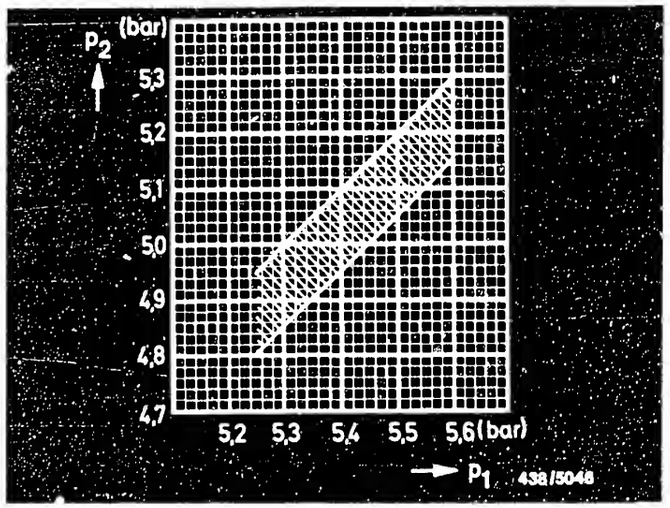
If any fuel connections are loosened or parts removed, also on the vacuum system, always use new seals when re-connecting or re-mounting.

Be sure to keep everything clean when working on the KE-Jetronic. Clean the external areas of fuel connections thoroughly before loosening them.

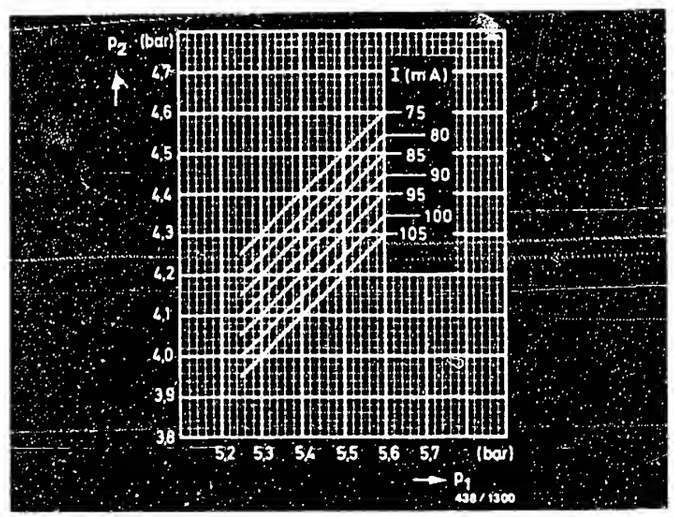
While conducting tests with the electric fuel pump running, never deflect (lift) the air-flow sensor plate, since this leads to fuel being injected via the injection valve. This may lead to very serious damage to the engine, when the engine is started afterwards.

TEST SPECIFICATIONS

No.	Test/Test condition	Test specification	
1	Electric fuel pump – delivery quantity:	min. 1000 cm^3 /min	
2	Primary pressure:	5,25...5,6 bar	
3	Differential pressure: Get lower–chamber pressure "warm" nominal value from the upper diagram corresponding to the measured primary press. (actuator current 10mA). Get the lower–chamber "cold" nominal pressure from the lower diagram corresponding to the measured primary pressure and actuator current. Tolerance ± 0.15 bar. Simulation of the "cold" state: pull the cable plug on the engine temperature sensor.		
4	Sealing test – entire system: Minimum pressure after 10 min.: Minimum pressure after 20 min.:	 2,7 bar 2,6 bar	
5	Fuel–injection valve opening pressure:	3,0...4,1 bar	
6	Delivery quantities – comparison measurement: (actuator current 0 mA) Idle: Part load: Full load: Minimum quantity at max. sensor–plate deflection	Setting point: (cm^3 /min) 10 6,6 42,8 109,0 cm^3 /min	Max. allow. quantity: (cm^3 /min) 6,0 40,0 100,0



p_1 = Primary pressure
p_2 = Lower–chamber pressure
I = Actuator current



TEST SPECIFICATIONS (CONTINUED)

No.	Test/Test condition	Set values	
7	Flow quantity, KE throttle:	120...145 cm ^{3} /min	
8	Temperature sensor (engine) NTC		
	Engine cold (+15...+30°C):	1,3...3,6 k Ω	
	Engine warm (approx. +80°C):	250...390 Ω	
9	Thermo-time switch, resistance measurement:	Below +10°C	Above +20°C
	Terminal G and ground:	50...70 Ω	50...70 Ω
	Terminal W and ground:	0 Ω	infinity Ω
	Terminal G and terminal W:	50...70 Ω	infinity Ω
10	Idle-mixture-adjusting screw, basic setting:		
	Fuel-distributor seat - needle-roller bearing:	21,2...21,4 mm	
11	Air-flow-sensor potentiometer:		
	Voltage signal, basic setting of air-flow sensor plate:	0,01...0,05 V	
12	Idle-speed adjustment: *)		
	Idle speed: (Controlled by idle-speed control)	800...920 min $^{-1}$	
	On/off ratio to be set: (bypass screw)	27...29 %	
	Exhaust-gas adjustm. via pressure-act. current:		
	Test specification:	4...16 mA	
	Setting:	9...11 mA	
	CO content in exhaust gas (check value):	0,3...3,0 % by vol.	

*) Refer also to following page

TEST SPECIFICATIONS (CONTINED)

*) Instructions for idle adjustment:

Exhaust-gas regulation is accomplished automatically by the lambda closed-loop control. The pressure-actuator triggering current in closed-loop operation (oscillating current reading) is tested. If the current reading is outside of the test specification, correct to the setting value by turning the idle-mixture-adjusting screw.

The CO control value is used to test whether there is any leakage in the exhaust system. Measure at the exhaust sampling pipe to the right of the intake manifold.

Switch off all electrical consuming devices as well as the air conditioner before idle testing. The radiator fan must not be running. Remove the PCV on the cylinder cover and leave open.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 WITH KE2 ADAPTER CABLE 1 684 463 135 AND SUITABLE MULTIMETER:

The following rapid diagnosis chart makes it possible for the experienced Jetronic specialist to rapidly test the electrical/electronic peripheral and control-unit functions of the KE-Jetronic, including lambda closed-loop control.

Important information concerning the following rapid diagnosis chart:

The "test conditions" column specifies the test steps during which the control-unit plug must be connected or disconnected. Great care must be taken to ensure that the system is without current during all plugging and unplugging operations, i.e. the ignition must be switched off and the electrical safety circuit must not be bridged.

The "test connections" column indicates the leads in the current path for the measurement being made, with reference to the pin assignment of the control-unit plug. Any trouble-shooting that may be required will involve these leads.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/But. V	Ω	Btn.	Test of	Test connections	Test conditions	Test specifications
1	| V	4	—	Pressure actuator internal resistance (R_1)	12 - 10	Disconnect control-unit plug.	20...30 Ω
2	| V	5	—	Internal resistance of engine temperature sensor	21 - 2	Control-unit plug disconnected. Engine temperature +15...+30°C: approx. +80°C:	 1.3...3.6 k Ω 250...390 Ω
3	| V	11	—	Control-unit output stage ground	20 - 2	Control-unit plug disconnected.	0...10 Ω
4	| V	9	—	Throttle-valve switch, idle	13 - 2	I m p o r t a n t : Voltage measurement; voltmeter connection: Negative = black socket "V" Positive = left blue socket " Ω " Control-unit plug disconnected. Switch on ignition. Throttle plate closed: Throttle plate open:	 8...15 V 0 V
5	| V	10	—	Throttle-valve switch, full load	5 - 2	I m p o r t a n t : Voltage measurement; voltmeter connection: Negative = black socket "V" Positive = left blue socket " Ω " Control-unit plug disconnected. Ignition switched on. Throttle plate closed: Throttle plate fully open:	 0 V 8...15 V
6	3	—	—	Air-conditioner signal (a/c readiness)	16 - 2	Control-unit plug disconnected. Switch on ignition. Switch on air conditioner:	 8...15 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/But. V	Ω	Btn.	Test of	Test connections	Test conditions	Test specifications
7	4	—	–	Start signal, terminal 50	24 – 2	Control-unit plug disconnected. Operate starting motor:	8...15 V
8	5	—	–	Ignition TD signal	25 – 2	Control-unit plug disconnected. Operate starting motor for a few seconds:	Voltage undefined
9	6	–	–	Control unit – supply	1 – 2	Control-unit plug disconnected. Switch on ignition.	8...15 V
10	7	–	–	Supply, air-flow sensor potentiometer	18 – 2	Connect control unit. Switch on ignition.	7...8 V
11	8	–	–	Signal, air-flow sensor potentiometer	17 – 2	Control unit connected. Switch on ignition. Sensor plate at rest: Deflect sensor plate by hand, continuous voltage rise to max. :	approx. 0 V 8 V
12	10	–	–	Idle actuator Supply and continuity, winding 1	3 – 2	Switch off ignition. Disconnect control-unit plug. Switch on ignition.	8...15 V
13	11	–	–	Idle actuator, continuity, winding 2	4 – 2	Control-unit cable plug disconnected. Switch on ignition.	8...15 V
14	12	–	–	Air-conditioner compressor signal	19 – 2	Switch off ignition. Connect control unit. Start engine and switch on air conditioner. Compressor not running: Compressor running:	0 V 8...15 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

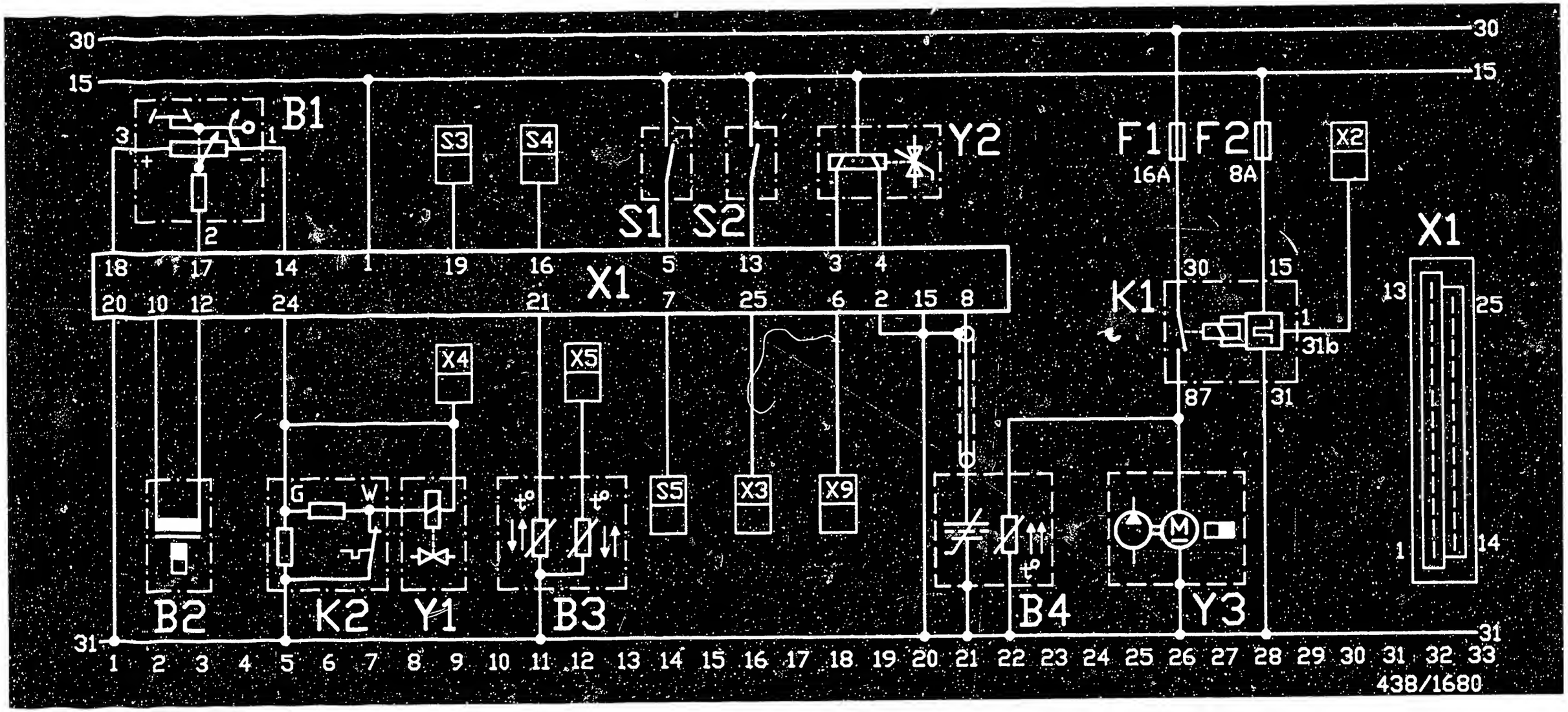
No.	Switch V	Switch Ω	/TA TA	Function tested	Test conn-ections	Test conditions	Set values
15	14	24	–	Lambda closed-loop control Control function	23 – 2	Control unit connected. Jumper sockets 1 and 2 on test adapter. Engine at operating temperature, run at idle. Control function: oscillating voltage indication. Average value:	 Approx. 3 V
16	–	–	1	Warm-up enrichment –20°C	12 – 12	Current measurement! To connect meas. instrument: Negative = Black socket 1 Positive = Black socket 2 Control unit connected. Switch on ignition.	 60... 80 mA
17	–	–	2	Actuator current Engine at operating temp.	12 – 12	Control unit connected. Switch on ignition.	 9... 11 mA
18	–	–	1 /4	Post-start enrichment	12 – 12	Control unit connected. Switch on ignition. Hold button 1 pressed: Press button 4. Current rises to: After holding steady for a short time, regulate slowly down to:	 60... 80 mA 130...160 mA 60... 80 mA
19	–	–	1 /6	Acceleration enrichment	12 – 12	Control unit connected. Switch on ignition. Hold buttons 1 and 6 pressed. Current value: Quickly deflect air-flow sensor plate. Current rises to: Regulation in approx. 1 second down to:	 60... 80 mA 110...160 mA 60... 80 mA

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch V	Switch Ω	/TA TA	Functions tested	Test conn-ections	Test conditions	Set values
20	–	–	2	Overrun cutoff	12 – 12	Control unit connected. Reconnect ammeter (reverse postive and negative). Start engine. Keep engine speed n at approx.: While holding button 2 pressed, actuate throttle-valve switch (idle). Current indication during phase of falling engine speed: Reconnect ammeter again.	 2000 min $^{-1}$ –30...–60 mA
21	–	–	–	Full-load enrichment	12 – 12	Control unit connected. Start engine and keep engine speed n at approx.: Actuate throttle-valve switch (full load). Current rises to:	2500 min $^{-1}$ 6...10 mA
22	–	24	–	Lambda closed-loop control Control function	12 – 12	Control unit connected. Engine at operating temperature, run at idle. Closed-loop-control operation can be recognized by oscillating current indication. Average value: If average value is outside tolerance limits, adjust (idle-mixture-adjusting screw) to:	 4...16 mA 9...11 mA
23	–	22	–	Lambda closed-loop control Rich stop	12 – 12	Control unit connected. Switch on ignition. Current rises to:	18...22 mA
24	–	23	–	Lambda closed-loop control Lean stop	12 – 12	Control unit connected. Switch on ignition. Current drops to:	0... 2 mA

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/But. V	Ω	Btn.	Test of	Test connections	Test conditions	Test specifications
25	10	–	–	Low-idle-speed control		Control unit connected. Test with lambda closed-loop control tester. Bridge black sockets 1 and 2 on test adapter.	
						Engine idling at normal operating temperature. Idle speed (regulated): On-off ratio at idle speed: If necessary, adjust on-off ratio (bypass screw on throttle-valve assembly).	800...920 min $^{-1}$ 27... 29 %
						Switch on air conditioner (compressor). Engine speed:	800...920 min $^{-1}$

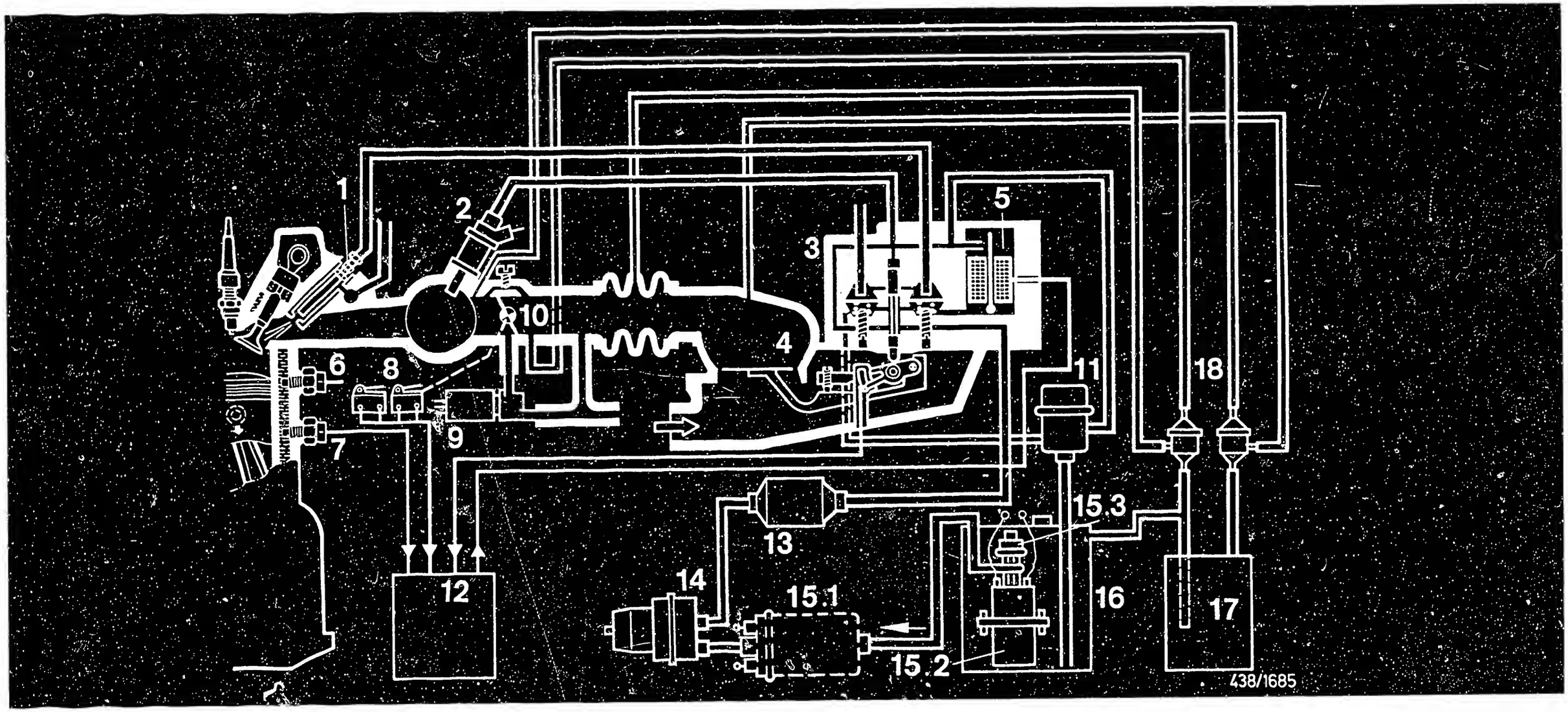


B1 = Air-flow-sensor potentiometer
B2 = Pressure actuator
B3 = Temperature sensor (engine)
B4 = Lambda sensor
F1 = Fuse (16 A)
F2 = Fuse (8 A)
K1 = Electric-fuel-pump relay
K2 = Thermo-time switch
S1 = Throttle-valve switch (full load)
S2 = Throttle-valve switch (idle)
S3 = Connection of air-conditioning compressor
S4 = Connection of air-conditioning standby
S5 = Connection of gear-shift switch
(with automatic transmission only)
X1 = Connector, KE control unit
X2 = Ignition coil, terminal 1
X3 = TD signal
X4 = Starting motor terminal 15a
X5 = Signal, air-conditioning standby
Y1 = Start valve
Y2 = Electric fuel pump

ELECTRICAL TERMINAL DIAGRAM

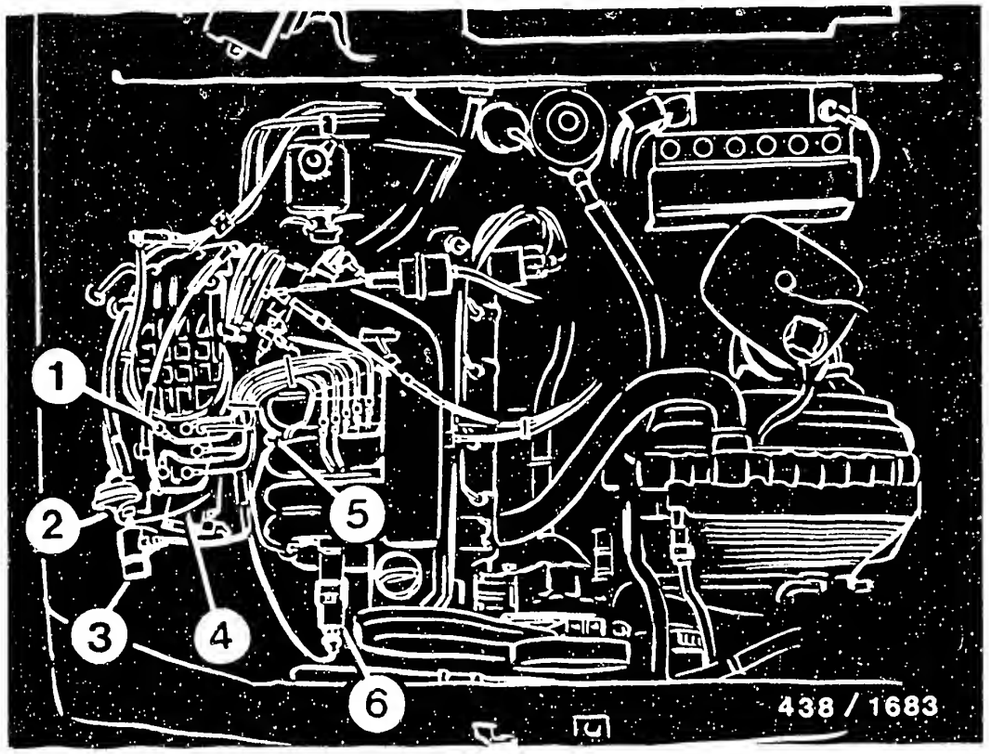
A21 ⟹

A22 ⟸



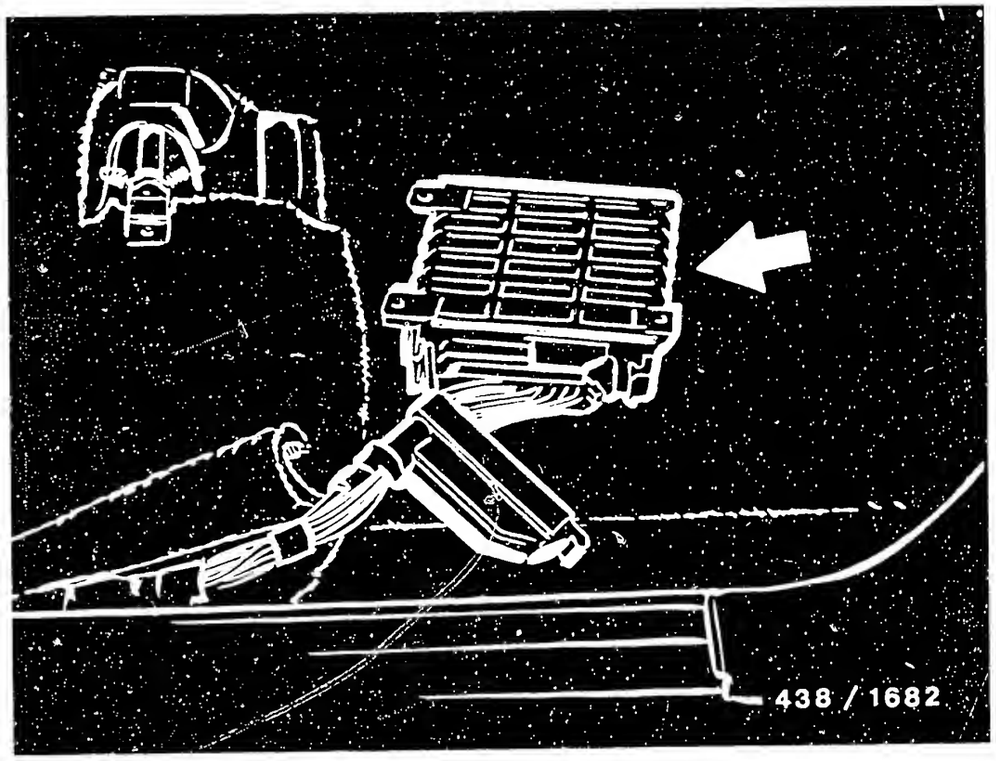
1 = Injection valve
2 = Cold-start valve
3 = Fuel distributor
4 = Air-flow sensor
5 = Pressure actuator
6 = Thermo-time switch
7 = Temperature sensor (engine)
8 = Throttle-valve switch (idle, full load)
9 = Idle actuator
10 = Throttle valve
11 = Primary-pressure regulator
12 = Control unit, KE-Jetronic
13 = Fuel filter
14 = Fuel accumulator
15.1 = Electric fuel pump (Audi 90, Coupe, 4000)
15.2 = In-tank electric fuel pump (Audi 100, 5000, Santana)
15.3 = Pressure damper (Audi 100 only)
16 = Fuel tank
17 = Activated-carbon canister
18 = Tank-ventilation switching valves

DIAGRAM OF AIR AND FUEL LINES



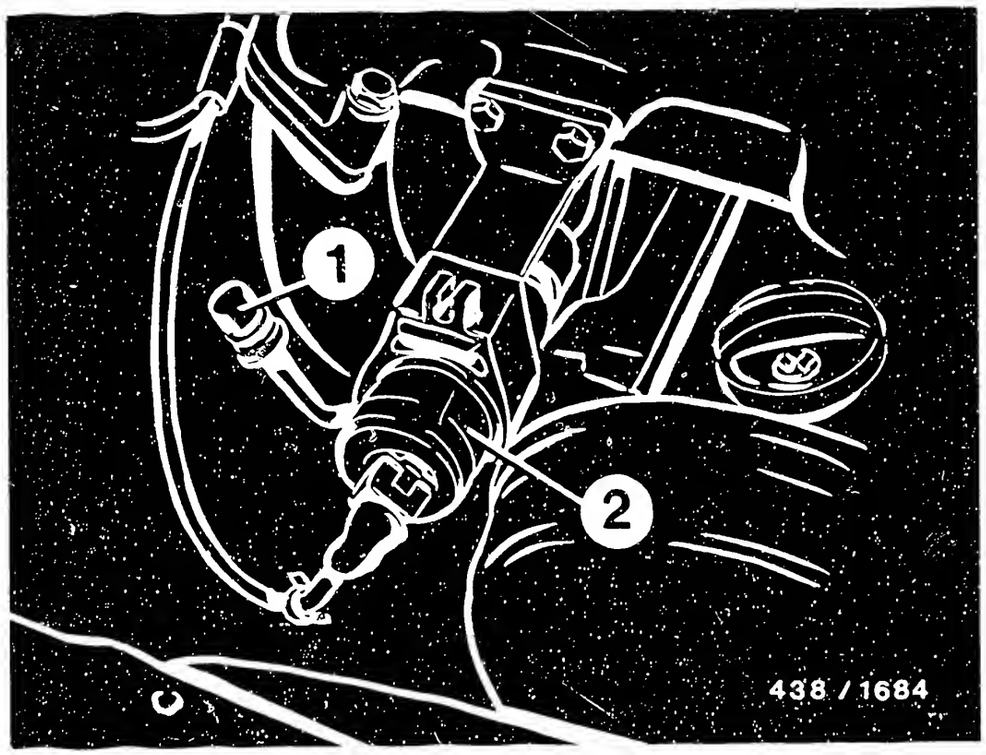
1 = Mixture-control unit
2 = Tank-ventilation valve
3 = Pressure regulator
4 = Pressure actuator
5 = Cold-start valve
6 = Idle actuator

INSTALLATION POSITION OF COMPONENTS



The KE control unit is located beneath the passenger seat.

Access to the KE control unit is gained by pulling back the footwell mat.



1 = Idle actuator
2 = Connecting pipe for exhaust-gas measurement

For production reasons:
continued on the following
coordinate.

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

Fuel filter and fuel accumulator are located near to the rear axle.

Trouble-shooting instructions : FOR-5005

BOSCH system : Motronic (EEC IV, Ford)

Make of vehicle : FORD

Basic microcard : PKW-015

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SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

*Ford Sierra
Ford Scorpio (D)
Ford Scorpio Granada (GB)
Ford Scorpio Merkur (USA)...2.9 Cat only
with 2.8 i / V6 engine (EFI) as of 04.85
2.4 i / V6 engine (EFI) as of 09.86
2.9 i / V6 engine (EFI) as of 09.86
2.9 i / V6 Cat engine (EFI) as of 09.86

EFI = Electronic Fuel Injection

*Engine control system EEC IV (characteristic-map ignition and fuel injection as with Motronic) with self-diagnosis and flashing-code output (special tester required):

*New on 2.4 and 2.9 l engines is:

1. Group injection: division into 2 groups which inject with staggered timing.
   Group 1:cylinders 1,2,4 (Cat: 1,4,6)
   Group 2:cylinders 3,5,6 (Cat: 2,3,5)
   Cylinder detection via trigger wheel of the Hall generator (trigger of cyl. 1 narrower).
2. Improvement of hot-starting by means of the fuel-temperature switch (not with Cat).

3. Pressure release valve in fuel-distribution pipe for bleeding air (e.g. after working on the fuel system) and pressure reduction (e.g. before fuel-pressure measurement).

Note on <u>basic</u> CO adjustment (with Cat):
Set CO screws of both air-flow sensors so that they are one rotation before the rich stop (turn to the right until stop is reached, then turn back 1 rotation)..
Then measure CO and if necessary, set to the specified value by turning both CO screws by the same amount.

SPECIAL FEATURES (Continued)

*Peculiar to the 2.9 l Cat engine:

1. Load sensing via intake-manifold pressure sensor (air-flow sensors not fitted).
2. Exhaust-gas recirculation (EGR) in addition.
3. Exhaust-gas afterburning (air-injection system), also known as secondary air, in addition, (with manually shifted transm. only).
4. Adaptation control (adaptive lambda closed-loop control) as on 2.0 l Cat engine.
5. Closed tank vent with activated-carbon canister and solenoid-operated valve (tank-ventilation valve).

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel and high-voltage flashovers when testing the compression.
  Therefore, disconnect main relay.

TROUBLE-SHOOTING CHART
Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts, but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (Ignition, fuel injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*		*	*	*	*	*	*		*		Control unit in emergency program
*											Safety switch
*											Pump fuse
*											Voltage at control unit
*											Main/pump relay
*	*	*		*							Central ground
	*	*	*	*	*	*					Air-flow sensor
	*	*	*	*	*	*					Intake-man./absol.-pressure sensor
*	*	*	*			*					Coolant-temperature sensor
					*	*					Air-intake temperature sensor
		*									Idle speed, CO
	*	*	*								Idle actuator
*	*	*	*								Air-induction system
					*						Throttle valve
		*	*		*						Throttle-valve potentiometer
		*									Overrun cut-off
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*		*		*							Magnetic pulse gen./ignition mod.
*		*		*	*						Ignition coil
*	*	*	*		*	*		*	*		Spark-advance angle
*		*			*	*					Fuel pressure
					*						Fuel delivery
*		*	*	*			*				Solenoid-operated injection valves

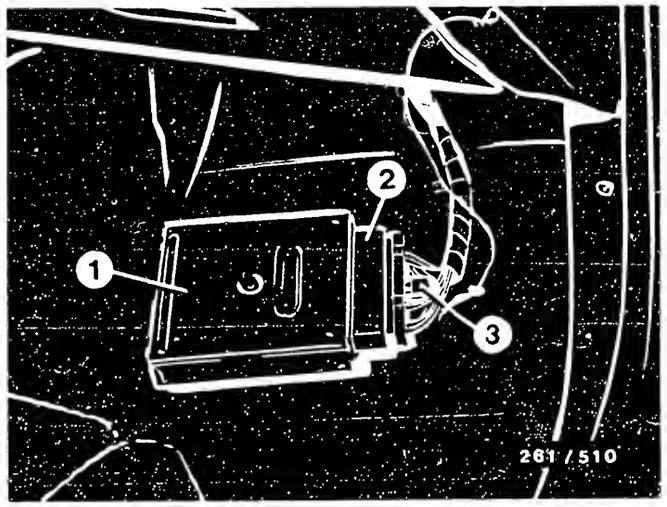
TROUBLE-SHOOTING CHART (Continued)

Customer complaint (symptoms of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts, but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, fuel injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
			*								Interference
		*	*	*							Interference-suppression resistors
		*	*								Lambda closed-loop control
		*									Exhaust-gas recirculation
		*									Air-injection system
	*	*	*				*				Tank vent
*	*	*	*	*	*	*	*	*	*		Control unit

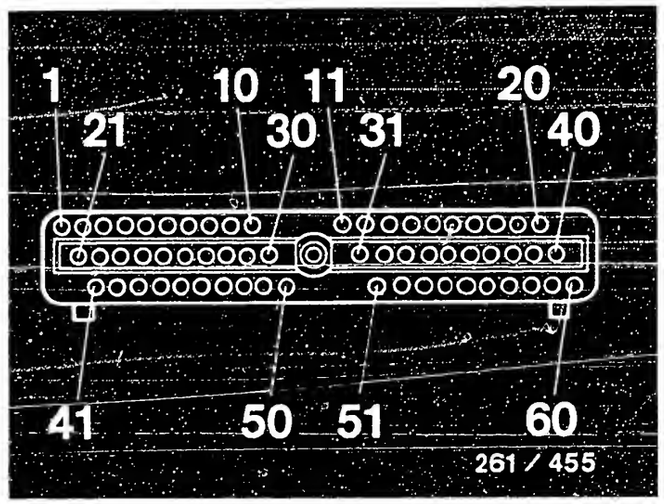
RAPID DIAGNOSIS CHART

Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
1	Switch off ignition, unscrew control-unit plug (upper illustration). Using test prods, measure resistance at open plug (lower illustration). Danger, do not damage contacts! If result is not within tolerance, repeat measurement at component and check wiring. Ground, control unit:	20 / vehic.ground	Less than 2,5 Ω
		40,60 / negative battery terminal	Less than 2,5 Ω
2	Engine-temperature sensor:	7 / 46	Engine cold 20...100 k Ω Engine at normal operating temp. 2... 10 k Ω
3	Air-intake temperature sensor: (+15°C...+30°C)	25 / 46	1,45...3,3 k Ω Cat: 20...60 k Ω
4	Throttle-valve potentiometer Throttle valve closed: Press accelerator pedal slowly to floor: Note: see "TEST SPECIFICATIONS" section also	47 / 26 47 / 46	2...5 k Ω 150...1500 Ω Continuous increase in resis.up to2,5...4,5k Ω
5 not with CAT	Air-flow sensor:	27+43/ 46 27+43/ 26	Each 25...120 Ω Each 250...600 Ω
6	Idle actuator: (Reverse polarity of instrument leads if test specification not obtained)	37 / 21	6...14 Ω
7	Injection valves (each time 3 valves in parallel):	37 /58+59	Each 4,5...6,0 Ω
8	Pump relay:	37 / 22	50...120 Ω
9	Ignition-module ground terminal:	16 / 40	0...2,5 Ω
10	Ignition module:	56 / 36	2...5,5 k Ω
11	Tank-ventilation valve:	31 / 37	50...120 Ω



1= EEC IV control unit
2= Control-unit plug (60-pin)
3= Fastening screw

60-pin control-unit plug (top view)



Test step	Testing of component/function Test instructions/conditions	Terminals	Set values
12	Electronic vacuum regulator (if EGR fitted):	33 / 37	30...120 Ω
13	Electronic pressure transducer (if EGR fitted): Note: measure only in k Ω range otherwise values read not within tolerance	27 / 46 26 / 27	Each approx. 40...400 k Ω
14	Secondary-air solenoid-operated valve (manually shifted transmission only):	51 / 37	50...120 Ω
15	Air-conditioner clutch:	10 / 40	2... 10 Ω
16	Shutoff relay for air conditioner (at full throttle):	54 / 57	50...160 Ω
17	N, D switch (automatic): (Manually shifted transmission):	30 / 40	Pos.P,N: <10 Ω Pos.D: infinity Ω infinity Ω
18 not with Cat	Plug for octane adjustment / idle increase (Disconnect plug used for measurement if connected); see illustrations. Idle increase : Octane adjustment 1: Octane adjustment 2:	 3 / 40 23 / 40 24 / 40	 Each infinity Ω
19	Fuel computer (if fitted):	34 / 40	5...500 k Ω
20	Ground loop in wiring harness:	49 / 16	Less than 2,5 Ω
Reconnect control-unit plug. Switch on ignition. Measure voltage after the plug.			
21	Voltage supply for control unit:	37 / 40	10...15 V
22	Voltage supply for throttle-valve potentiometer, air-flow sensor, and/or intake-manifold pressure sensor:	26 / 46	4,5...5,5 V
23 not with Cat	Air-flow-sensor tap: Deflect air-flow sensor flap slowly to end stop:	27+43/ 46	Each 0,2...0,3 V Voltage increases up to at least 4,2 V
24	Fuel-pump relay: Pump energization (leave engine running):	22 / ground	10...15 V Max. 4 V
25	Voltage supply, idle actuator Switch on ignition:	21 / ground	10...15 V

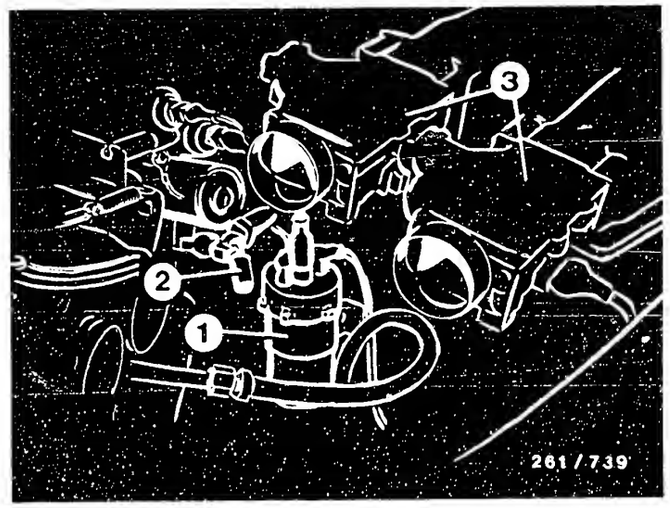
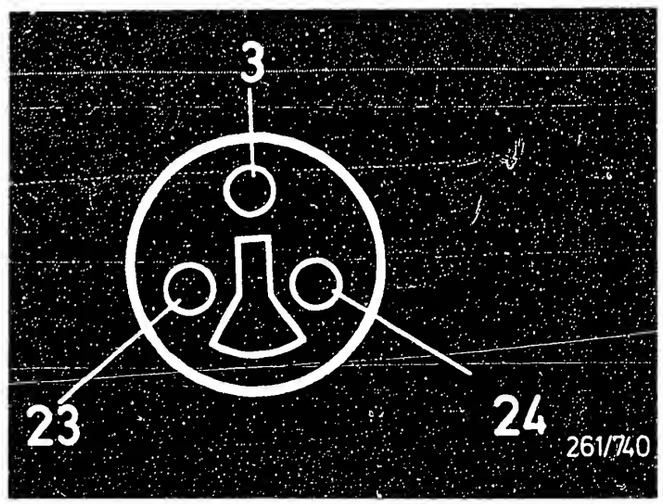


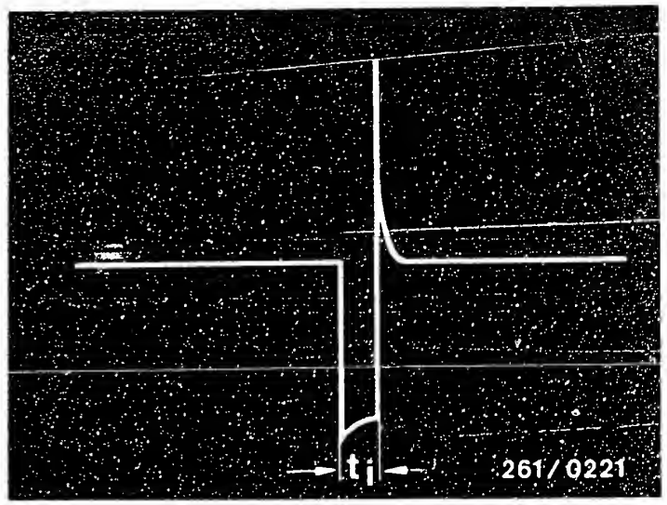
Illustration: Sierra 2.8i
1= Ignition coil
2= Plug for octane/idle adjustment (red cap if plug open)
3= Air-flow sensor

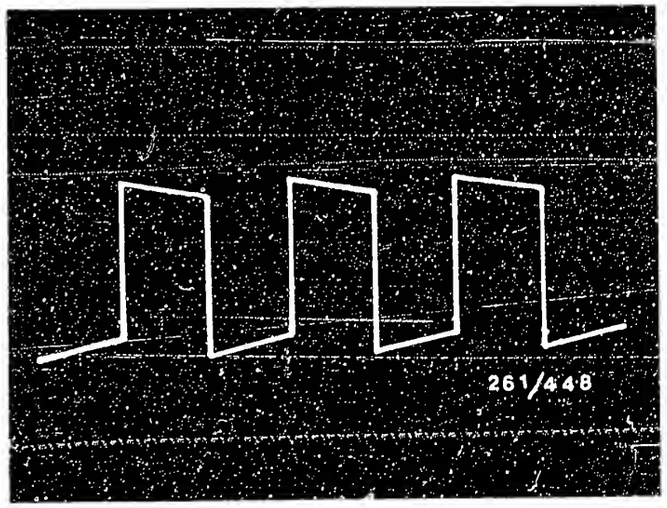
3-pin plug for octane/idle adjustment
Terminal 3 to ground: idle increase
Terminals 23 and/or 24 to ground: spark-advance-angle adjustment

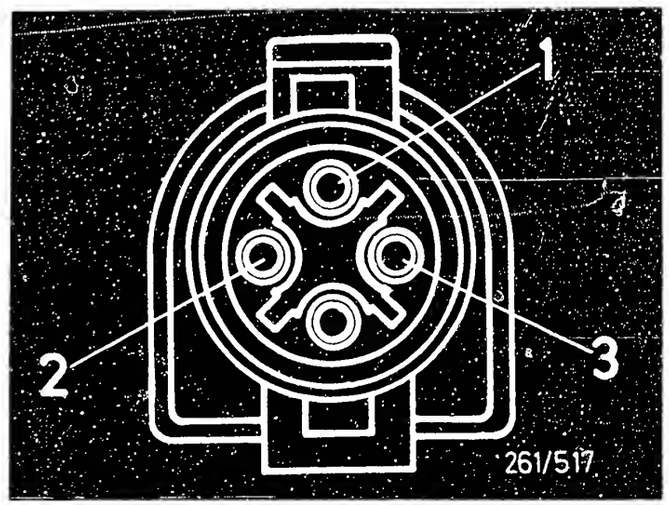


RAPID DIAGNOSIS CHART (CONTINUED)

Test step	Testing of components/function Test instructions/conditions	Terminals	Set values
26 Cat only	Voltage supply, tank-ventilation valve Switch on ignition:	31 / ground	10...15 V
27	Voltage supply, electronic vacuum regulator (if EGR fitted), switch on ignition:	33 / ground	10...15 V
28 Cat only	Voltage supply, secondary-air solenoid-operated valve Switch on ignition:	51/ ground	10...15 V
29	Injection signal (2 groups); start engine:	58 /grd. 59 /grd.	See upper illustration
30	Magnetic pulse generator and control unit Special osci input; start engine:	37 / 56 37 / 36	See center illustration
31	Intake-manifold vacuum sensor (if fitted) Special osci input; switch on ignition: (Signal frequency engine-speed and load dependent)	45 /grd.	Signal similar to that in center illustration
32	Spark-advance angle at idle (max. 900 min $^{-1}$): (2.9 Cat: 10...20° crankshaft before TDC)	——	7...17° crankshaft before TDC
33	Vehicle-speed sensor Special osci input:	4/ground (Cat: 3/grd.)	Wave curve when a rear wheel spins.
34 Cat only	Lambda closed-loop control Measure CO (engine and catalytic converter at normal operating temperature): Disconnect air hose from fuel-pressure regulator and seal off: Note: if result negative ... 1. Repeat test at higher engine speed 2. Check lambda-sensor plug-in connection 3. Check control unit (rich/lean stop): Pull apart sensor plug-in connection; connect terminal 1 (lower illustration) to ground for rich stop (CO increases) or to positive terminal of a 1.5 V monocell for lean stop (CO) drops. Negative term of monocell to veh. ground! 4. Exchange lambda sensor.	29 / 40	Approx 0% CO by vol. (after catalytic converter) CO rises briefly and drops back to 0% by vol.







TEST SPECIFICATIONS

Measured directly at the component.

Idle test
Engine at normal operating temperature, switch off loads, automatic transmission to "P" or "N".

Idle speed:	2.8...	800...900 min $^{-1}$
	2.4 / 2.9...	750...850 min $^{-1}$
	2.9 Cat...	850...950 min $^{-1}$
	(Automatic...	800...900 min $^{-1}$)

Spark-ad. angle:	2.8 / 2.4 / 2.9...	7... 17°	crankshaft before TDC
	2.9 Cat...	10... 20°	crankshaft before TDC

CO content (without catalytic converter): 0,5...1,0 % CO by vol.

2.8 l: Mixture adjustment at the bypass screw of the front air-flow sensor.

2.4 / 2.9 l: To adjust the CO, turn both bypass screws by the same amount (when making the basic setting or when idle is rough, take the right-hand stop of both bypass screws as starting position).

CO content (with catalytic converter): approx. 0 % CO by vol.
Note: Engine and catalytic converter must be at normal operating temperature. Not possible to adjust.

Intake-manifold pressure sensor
Internal electrical resistance between

Term. 45 and term. 26 :	800... 900 Ω
Term. 45 and term. 46 :	1300...1400 Ω

Air-flow sensor
Internal electrical resistance between

Term. 7 and term. 6 :	8...2500 Ω (*)
Term. 9 and term. 6 :	500...1100 Ω

(*) Deflect air-flow sensor flap slowly as far as it will go. Resistance increases unsteadily (fluctating) and drops slightly at end.

TEST SPECIFICATIONS (CONTINUED)

Pressure regulator

Fuel pressure:	2,3...2,7 bar
	(Cat: 2,5...2,9 bar)

Electric fuel pump

Delivery (measured in return):	at least 750 cm ^{3} /30s
Pre-supply pump: (if fitted)	at least —— cm ^{3} /30s
Supply voltage (under load):	at least 12 V

Solenoid-operated injection valve
Internal electrical resistance at ambient temperature
(+ 15° C...+ 30° C): 15...17,5 Ω

Coolant-temperature sensor
(color of plug: blue)
Internal electrical resistance at ambient temperature
(+15°C...+30°C): 20...60 k Ω
with engine at normal operating temperature
(approx. + 80° C): 2... 6 k Ω

Air-intake temperature sensor
Internal electrical resistance measured at air-flow sensor (with white connector) between term. 22 and term. 6 at ambient temperature
(+15°C...+30°C): 1,45...3,3 k Ω

2.9 Cat (+15°C...+ 30°C): 20...60 k Ω

TEST SPECIFICATIONS (CONTINUED)

Throttle-valve potentiometer
Total internal electrical resistance: 3,2... 4,8 k Ω
(Cat: 2,0... 5,0 k Ω)
Resistance at wiper with
closed throttle valve
2.8 l: 220... 800 Ω
2.4 / 2.9 l: 150...1200 Ω
Cat: 300...1500 Ω
fully opened throttle valve: 2,5... 4,5 k Ω
(Cat: 3,5... 4,3 k Ω)

Idle actuator
Internal electrical resistance: 6... 14 Ω

Lambda sensor
Resistance with heater winding: 1... 15 Ω

Tank-ventilation valve
Internal electrical resistance: 50... 120 Ω

Secondary-air solenoid-operated valve
Internal electrical resistance: 60... 80 Ω

Electronic vacuum regulator (EGR)
Internal electrical resistance: 30...120 Ω

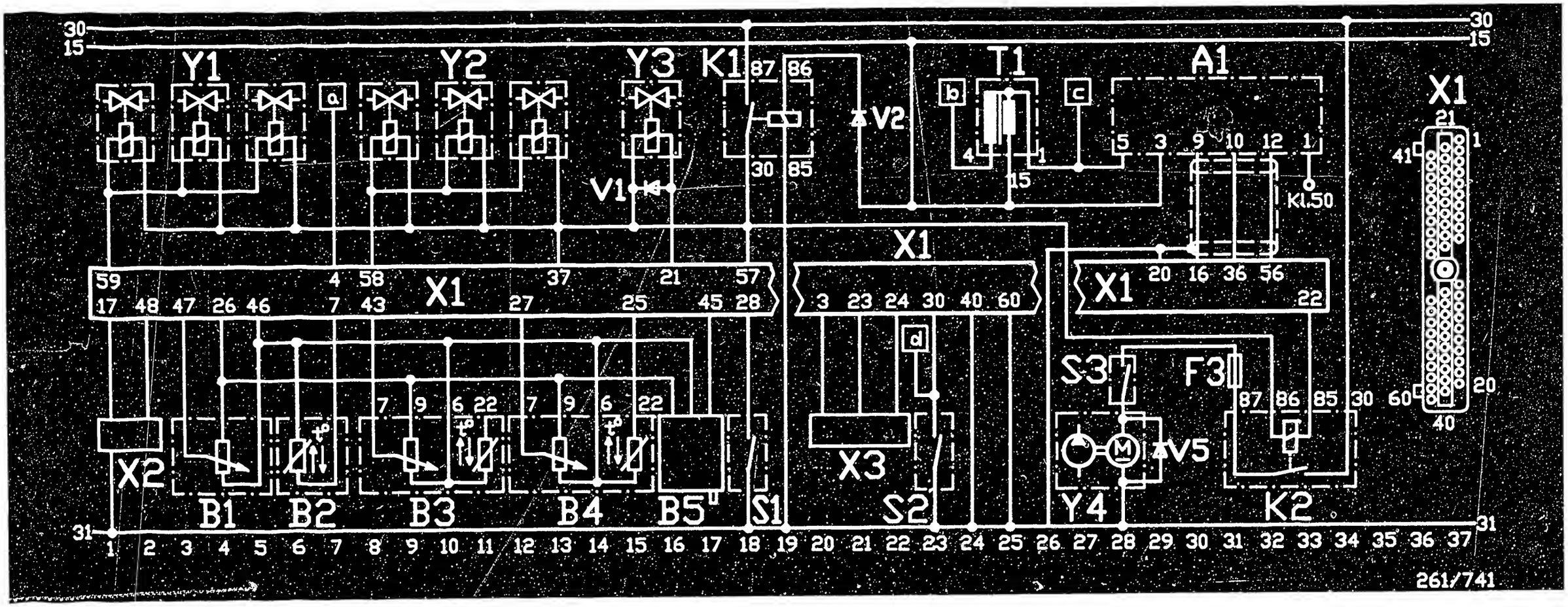
Electronic pressure transducer (EGR)
Electrical input
resistance approx. 40...400 k Ω

Ignition coil
Primary resistance: 0,68...0,91 Ω
Secondary resistance: 4,3...7,3 k Ω

High-voltage cable
Electrical resistance per cable: max. 30 k Ω

See equipment and Autodata microcards for settings for valve clearance and other engine-related data.

For production reasons:
continued on the following coordinate.



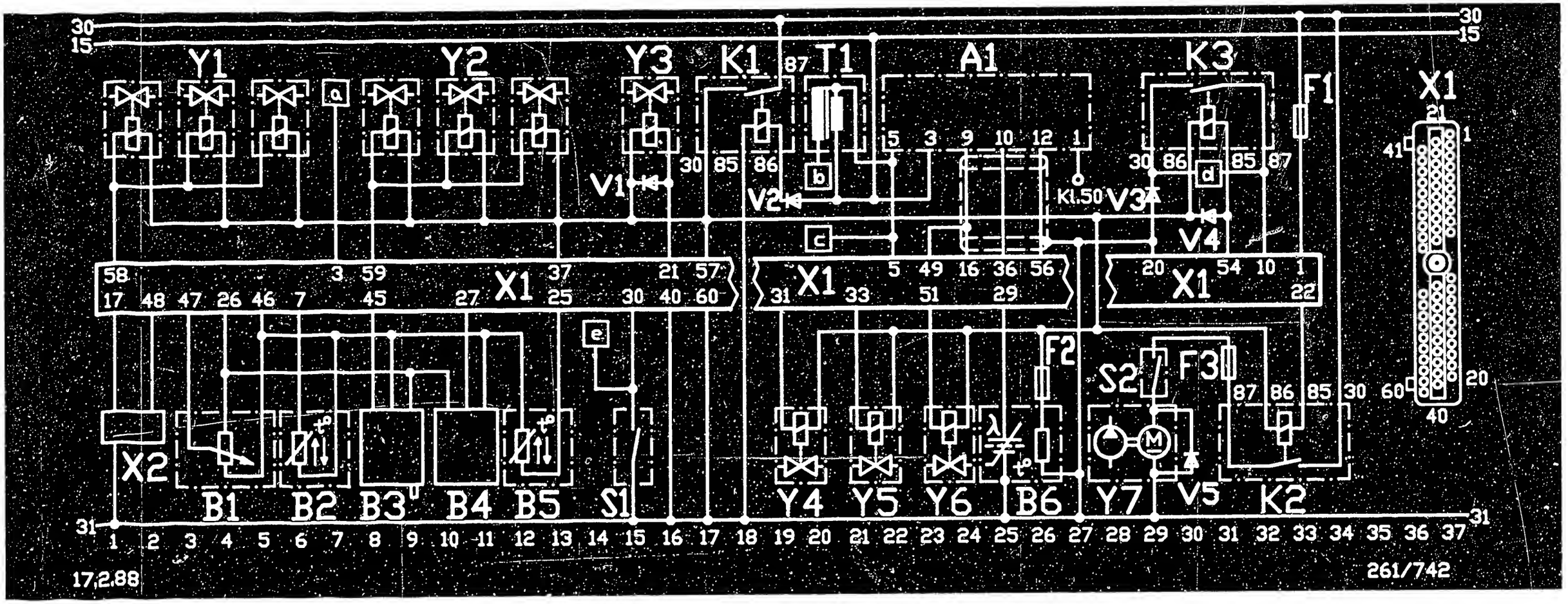
A1=Ignition module
B1=Throttle-valve potentiometer
B2=Coolant-temperature sensor
B3=Air-flow sensor 2 (cyl.4,5,6)
B4=Air-flow sensor 1 (cyl.1,2,3)
B5=Intake-manifold-pressure/absolute-pressure sensor (South Africa only)
F3=Pump fuse
K1=Main relay
K2=Pump relay

S1=Fuel-temperature switch (not on 2.8 l)
S2=N,D switch (automatic)
S3=Safety switch (not on 2.8 l)
T1=Ignition coil
V1,V5=Cutoff diodes
V2=Reversed-polarity protection diode
X1=Control-unit plug
X2=Self-diagnosis plug
X3=Plug for idle adaptation and octane-rating adaptation

Y1=Injection valves (cyl.1,2,4) (2.8 l: cyl.4,5,6)
Y2=Injection valves (cyl.3,5,6) (2.8 l: cyl.1,2,3)
Y3=Idle actuator
Y4=Electric fuel pump
a=Input, "speed sensor"
b=To high-voltage distributor
c=To tachometer
d=To indicator, "selection-lever position" (automatic only)

ELECTRICAL TERMINAL DIAGRAM (2.8 l / 2.4 l / 2.9 l)

B17 ⟹ B18 ⟺



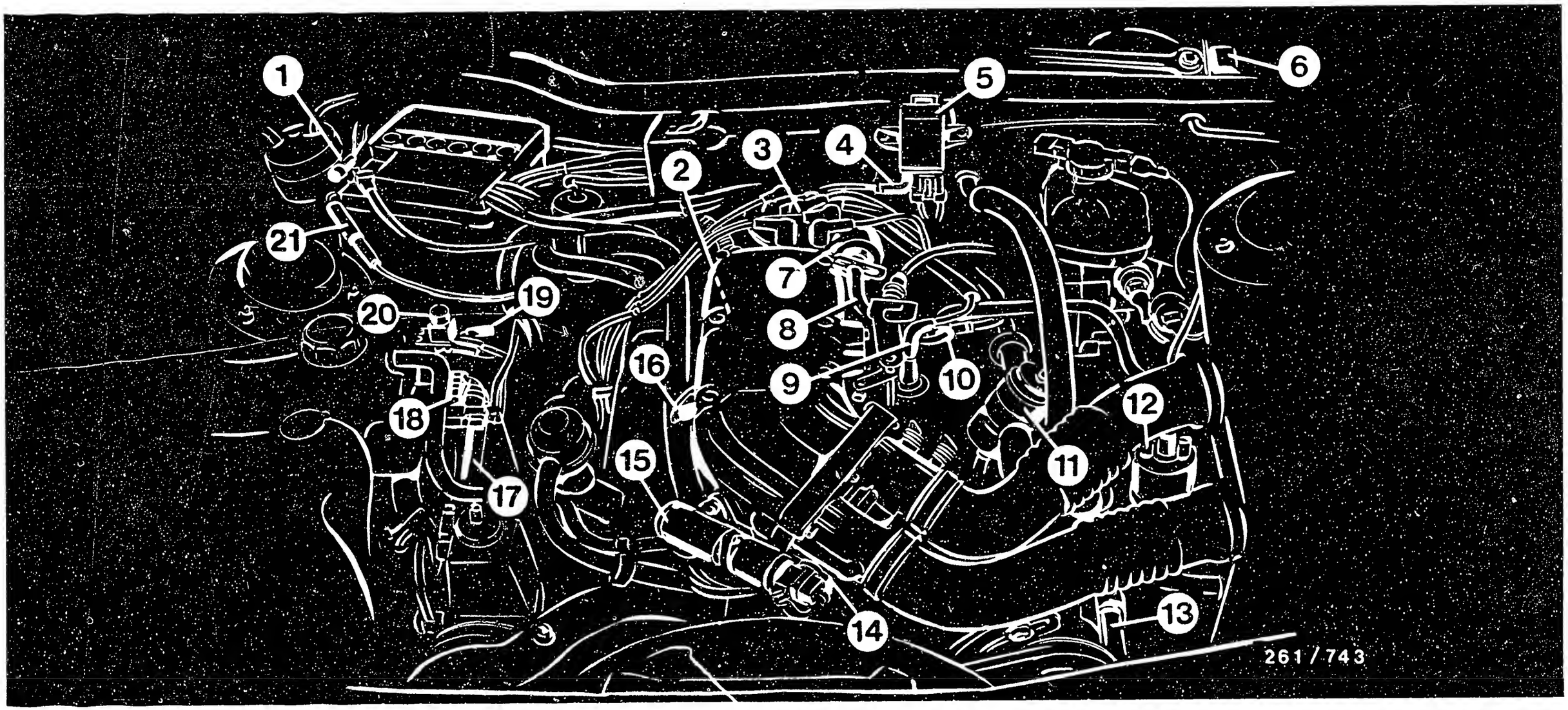
A1=Ignition module
B1=Throttle-valve potentiometer
B2=Coolant-temperature sensor
B3=Intake-manifold pressure sensor
B4=Electronic pressure transducer (EGR)
B5=Air-intake temperature sensor
B6=Heated lambda sensor
F1=Fuse for continuous positive
F2=Fuse for sensor heater
F3=Pump fuse

K1=Main relay
K2=Pump relay
K3=Cutoff relay for air conditioner (at full throttle)
S1=N,D switch (automatic)
S2=Safety switch
T1=Ignition coil
V2,V3=Reversed-polarity protection diodes
V1,V4,V5=Cutoff diodes
X1=Control-unit plug
X2=Self-diagnosis plug
Y1=Injection valves (cyl.1,4,6)

Y2=Injection valves (cyl.2,3,5)
Y3=Idle actuator
Y4=Tank-ventilation valve
Y5=Vacuum regulator (EGR)
Y6=Secondary-air solenoid-op. valve (with manually shifted transm. only)
Y7=Electric fuel pump
a=Input, "speed sensor"
b=To high-voltage distributor
c=To tachometer
d=To air-conditioner clutch
e=To indicator, "selection-lever pos."

ELECTRICAL TERMINAL DIAGRAM (2.9 l Cat)

B19 — <==> B20 — <==



1 = Self-diagnosis connection
2 = Ignition module
3 = High-voltage distributor
4 = Intake-manifold connection of intake-manifold pressure sensor
5 = Intake-manifold pressure sensor
6 = Fuse box
7 = Fuel-pressure regulator
8 = Fuel-return line
9 = Vacuum hose to tank-ventilation valve
10 = Fuel-inlet line
11 = Vacuum-controlled air valve (Secondary air)
12 = Ignition coil
13 = Air-injection pump (Secondary air)
14 = Throttle-valve potentiometer
15 = Idle actuator
16=Air-intake temperature sensor
17=Activated-carbon canister
18=Electronic vacuum regulator (EGR)
19=Tank-ventilation valve
20=Secondary-air solenoid-operated valve
21=Lambda-sensor plug-in connection

INSTALLATION POSITION OF COMPONENTS (Scorpio 2.9 i Cat)

| B21 | — | ⟹ |

| B22 | — | ⟺ |

INSTALLATION POSITION OF COMPONENTS (Continued)

The indications "right" and "left" always refer to the forward direction of travel.

Control unit:
In the footwell on the passenger's side beneath the instrument panel.

Control-unit ground connections:
Near to the control unit (term. 20) and directly at the negative terminal of the battery (term. 40 / term. 60).

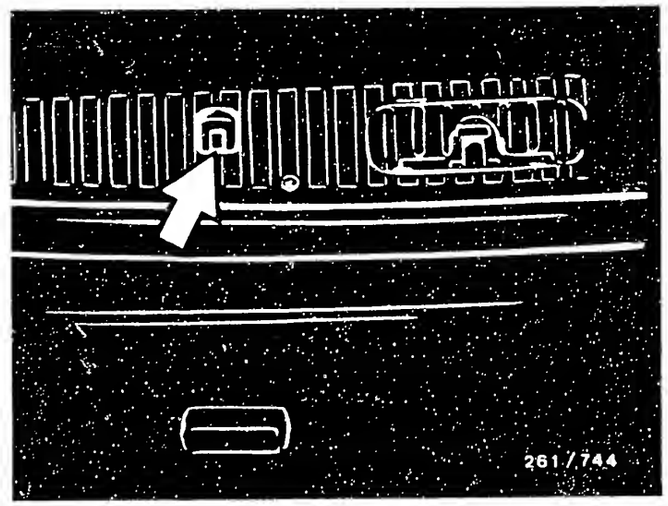
Safety switch:
Scorpio: beneath the rear body panel next to the luggage-compartment lock. (Upper illustration, arrow; actuate button).
All other models: on the floor pan beneath the spare wheel.

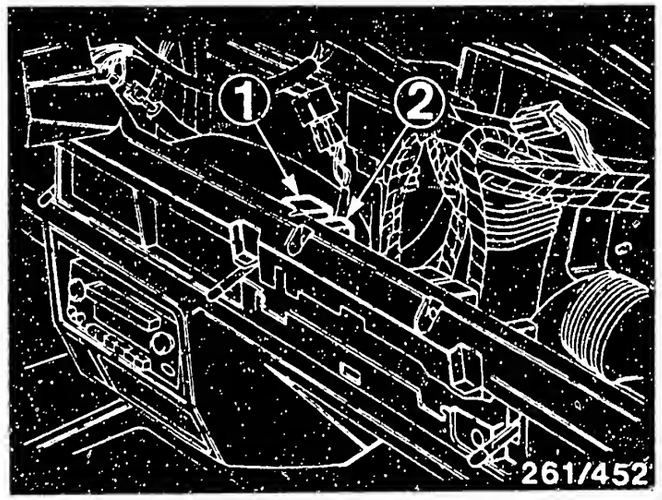
Main and pump relays:
In the Scorpio, behind the instrument panel
(Center illustration, Item 1 = Pump relay
Item 2 = Main relay).
In the Sierra, near to the control unit
(Lower illustration, arrows).

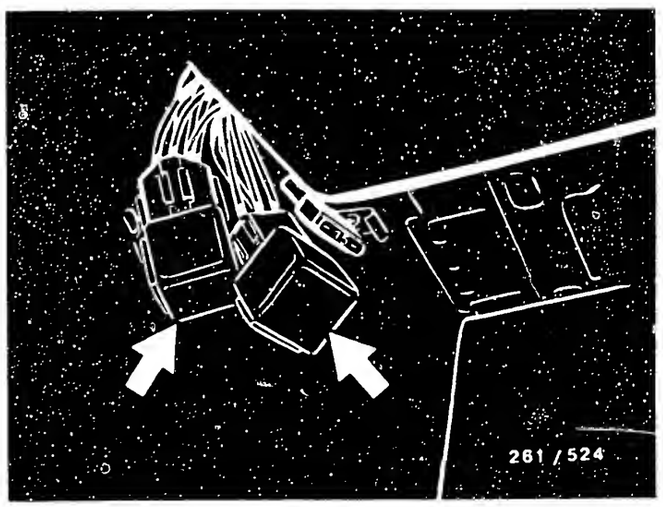
Pump fuse:
In the glove compartment.

Fuel pump:
Beneath the vehicle near to the fuel tank.

Fuel filter:
Near to the fuel pump or in the engine compartment on the firewall on the left-hand side.







INSTALLATION POSITION OF COMPONENTS (Continued)

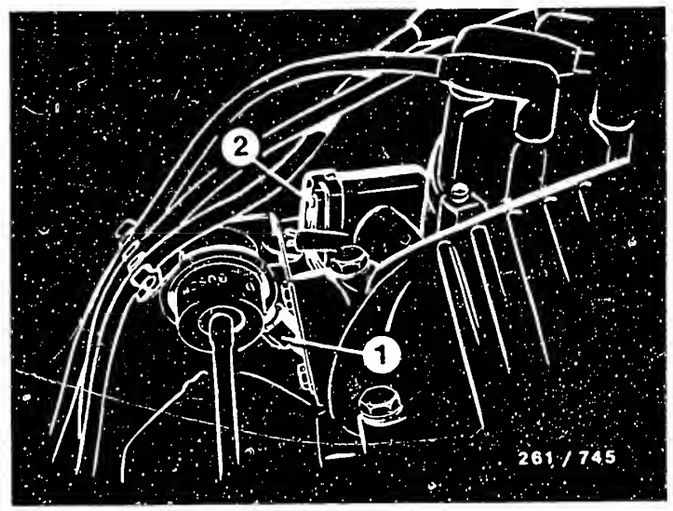
Fuel-pressure pressure-gauge connecting point:
2.8 l : on the pressure regulator (upper illustration, Item 1)
2.4 / 2.9 l : Plug-in fastening in the fuel-inlet line (center illustration, Item 3).

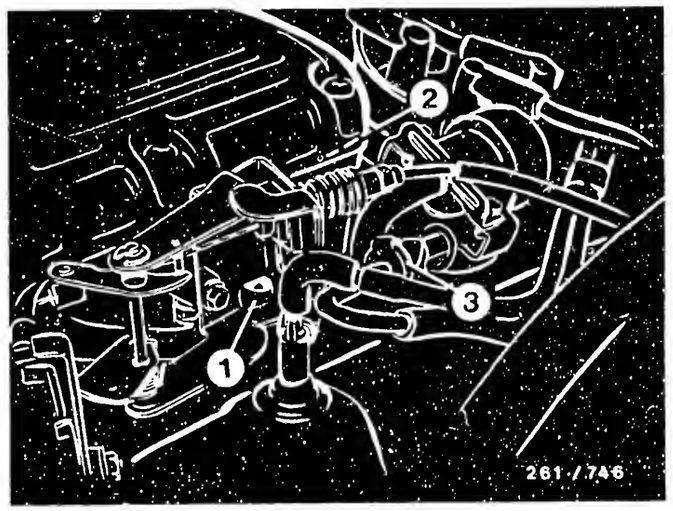
Pressure release valve (similar to a tire valve; with protective cap):
Screwed into the fuel-distribution pipe near to the throttle cable. See center illustration, Item 1 (not immediately visible).

Fuel-temperature switch (not with Cat):
Screwed into the back end of the fuel-distribution pipe.
See center illustration, Item 2 (not immediately visible).

Ignition module:
On the ignition distributor, (upper illustration, Item 2).

Ignition marking:
On the front of the engine block (lower illustration, arrow).





Throttle-valve potentiometer:

On the throttle-valve assembly
(2.8 l : upper illustration, Item 1).
(2.4 / 2.9 l: center illustration, Item 1)

Coolant-temperature sensor:

In the thermostat housing
(2.8 l : upper illustration, Item 2)
(2.4 / 2.9 l: center illustration, Item 2)

Air-intake temperature sensor (not with Cat):

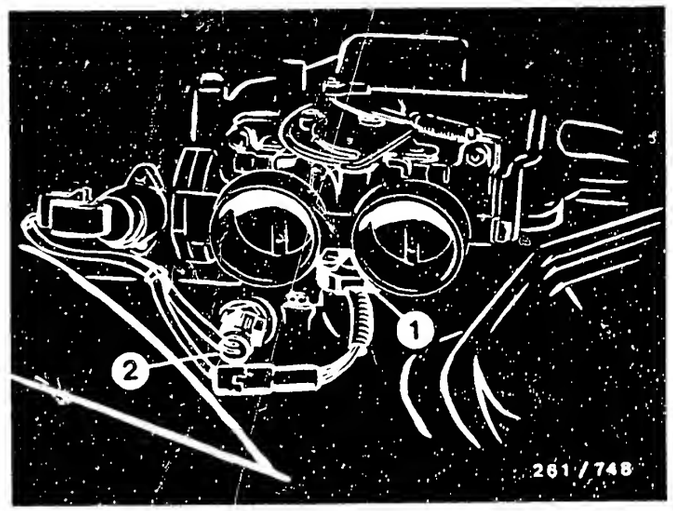
Integrated into the air-flow sensor.

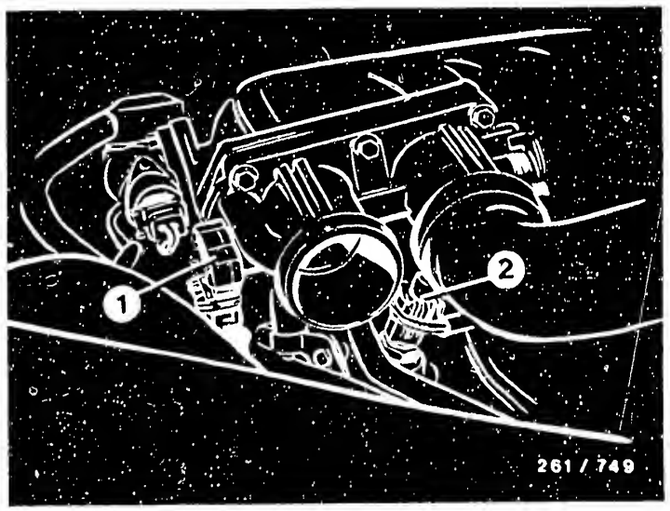
Lambda sensor (Cat only):

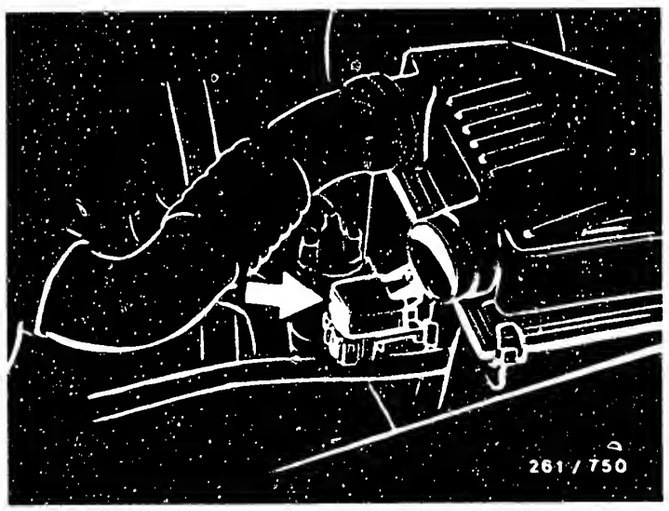
In the common exhaust pipe.

Electronic pressure transducer (EGR):

On the air-filter housing (lower illustration, arrow).







Trouble-shooting instructions : MB-5033

BOSCH system : Electronic Traction Control (ASR2 - DKB)

Make of vehicle : DAIMLER-BENZ

Basic microcard : PKW-092

TABLE OF CONTENTS

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SPECIAL FEATURES

This microcard contains the trouble-shooting instructions, valid at the time of publication, for the following models:

* DB Type W/C 126, 7.87->

Electronic Traction Control (ASR) combined with ABS2. ASR takes action on (intervenes in) the brakes and E Gas.

New components:

+ Common controller for ABS and ASR,
+ ABS hydraulic modulator adapted to ASR,
+ ASR hydraulic modulator,
+ Pressure accumulator with charge pump.

Special adapter lead is required for testing. The adapter lead has 2 pin terminals: one for connection to the ABS 2 LED tester for the ABS test and a second terminal for connection to the universal test adapter for testing the ASR.

NOTE!!

ABS and ASR are systems for vehicle safety. Working on these systems requires detailed knowledge of the systems. Testing must be conducted only by trained personnel.

SAFETY AND PRECAUTIONARY MEASURES

*Before loosening the brake lines from the hydraulic modulators, the charge pump or the pressure accumulator, the pressure accumulator must be emptied.
Caution! High pressure up to 200 bar!
Switch off the ignition. Open the bleeder screw SP3 on the ASR hydraulic modulator approx. 1 rotation and allow the brake fluid to flow into a container.

*When repairs are carried out on a brake caliper or on the brake hose at the wheel end, the system must be bled as usual.

*When repairs are carried out on the brake master cylinder, on the hydraulic modulators, the charge pumps, or on the pressure accumulator, the system must be bled in accordance with the specified sequence (see bleeding specifications).

*For safety reasons, the hydraulic modulator must not be repaired, but be exchanged only as a complete unit.
Exception: relays.

*Do not loosen any screws on the hydraulic modulator! Danger of fatal accident due to brake failure.

*Caution when handling brake fluid.
Poisonous

*Before testing on the chassis dynamometer and the dynamic brake analysers, disconnect the ABS/ASR controller plug.

*The vehicle may be towed with the front axle raised only when the ignition is switched on.

For further information, see basic instructions.

Customer complaint:

ASR warning lamp lights up.

Test procedure:

+Switch off ignition.
+ABS/ASR controller connected.
+Disconnect E Gas control unit.
+Bridge term. 31 and term. 34 at E Gas plug.

+Switch on ignition:
1 ASR warning lamp no longer lights up:
+E Gas control unit defective.

2 ASR warning lamp continues to light up:
+Leads to E Gas control-unit plug term.31 and term. 34. Test using test adapter Test step 1.
+Conduct full test using ABS2 LED tester and universal test adapter.
+If no fault can be determined: exchange ABS/ASR controller.

Note:

Only one ground LED lights up in program-selector-switch position 1 during the ABS test, since ground terminal 10 is not fitted on ABS/ASR.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01

Adapter lead: 1 684 463 199. Do not drive with test adapter connected!

Test step	Switch V	Switch Ω	Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
1	| V	3	13–16	Lead to E Gas control unit	Ignition off. Disconnect E Gas control unit and bridge the terminals 31 and 34 at the plug.	Less than 10 Ω
2	| V	9	22–33	Coil resistance of motor relay K4	Ignition off.	40...65 Ω
3	| V	16	30–31	Coil resistance of change-over valve	Ignition off.	5... 8 Ω
4	4	16	1–20	Voltage supply for controller	Ignition on.	10.3...15 V
5.1	7	16	——	ASR warning lamp	Ignition on. Visual examination of ASR warning lamp. Note: ABS 2 LED tester must not be on test step 5.	ASR warning lamp lights up
5.2	7	16	17–20	Valve relay (diode, break contact) and resistor in base	Ignition on.	0,5...1,5 V
6	7	16	10–20	ASR function indicator	Ignition on. Actuate push-button 3. Visual examination of ASR function indicator.	ASR function indicator lights up
7	7	16	3–20	Indicator lamp for snow-chains switch	Ignition on. Actuate push-button 2. Visual examination of indicator lamp.	Snow-chains indicator lamp lights up
8	8	16	5–20	Snow-chains switch	Ignition on. Actuate snow-chains switch.	10,3...15 V
9.1	10	16	8–20	Pressure switch in operating-pressure position	Ignition on. Actuate push-button 1 (valve relay picks up). Note: accumulator pressure must be available, so that pressure-switch contact switches to ground. Generate charge pressure as required.	= < 0,5 V
9.2	10	16	8–20	Pressure switch. Pressure less than operating pressure.	Ignition off. Connect hose to connection SP of hydraulic modulator and dangle into a container. Reduce accumulator pressure by opening the connection SP. Ignition on. Actuate push-button 1.	10,3...15 V
10	10	16	8–20	Resistance in ASR hydraulic modulator	Ignition off. Note: Resistance is measured at the voltage sockets!	1,4...1,7 k Ω

C05 — ⟹

C06 — ⟸

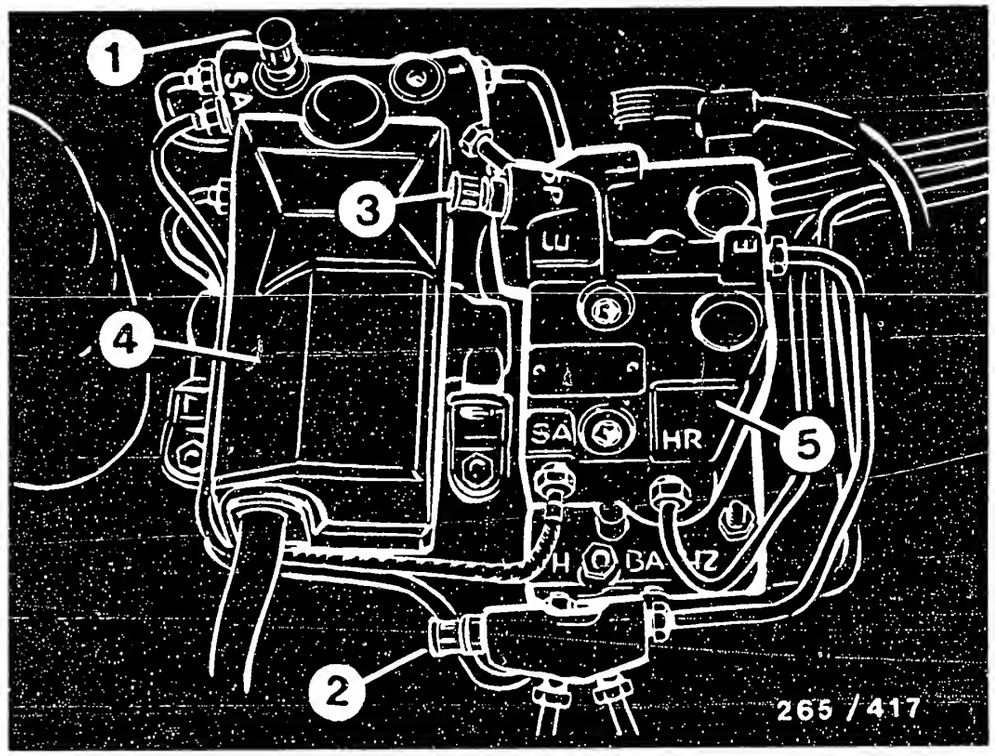
Dynamic test of ASR 2-DKB

Test requirements:
+Conduct test using universal test adapter.
+ABS/ASR controller connected.

Test procedure:

1. Dynamic test of system operation:
   +Rear left wheel must be clear of the ground.
   +Shift selection lever of transmission to N.
   +Switch on ignition.
   +Turn free wheel rapidly by hand.
   +Wheel must be braked briefly by ASR control.
   +Return-supply pump must operate audibly.
   +Conduct the same test on the rear right wheel.
   +Switch off ignition.

2. Test accumulator charging control:
   +Ignition off.
   +Connect hose to bleeder screw SP3 (on ASR hydraulic modulator) and dangle into a container.
   +Open connection SP3 carefully and reduce pressure.
   Caution! high pressure up to 200 bar possible!
   +Connect pressure gauge (up to 250 bar) to connection SP3.
   +Top up brake-fluid reservoir to Max. mark.
   +Start engine.
   +Perform time measurement:
   ++The accumulator is charged as soon as the engine is running. After 1 to 2 seconds, the pressure must have risen to above 90 bar.
   ++Afterwards, the pressure rises more slowly:
   The pressure must rise to 150 to 185 bar within 7 to 15 seconds
   (Subsequent charging possible).
   Set values apply at room temperature.
   +Switch off engine, switch off ignition.
   Caution! if the pressure rises above 250 bar, switch off ignition immediately! Pressure switch defective.



1 = Bleeder screw 1
2 = Bleeder screw 2
3 = Bleeder screw SP3
4 = ABS hydraulic modulator
5 = ASR hydraulic modulator

3. Measuring pressure loss.
   After 5 minutes, the pressure must have dropped by no more than a max. of 6 bar (taking 150...185 bar as the basis).
   Measurement applies at room temperature.

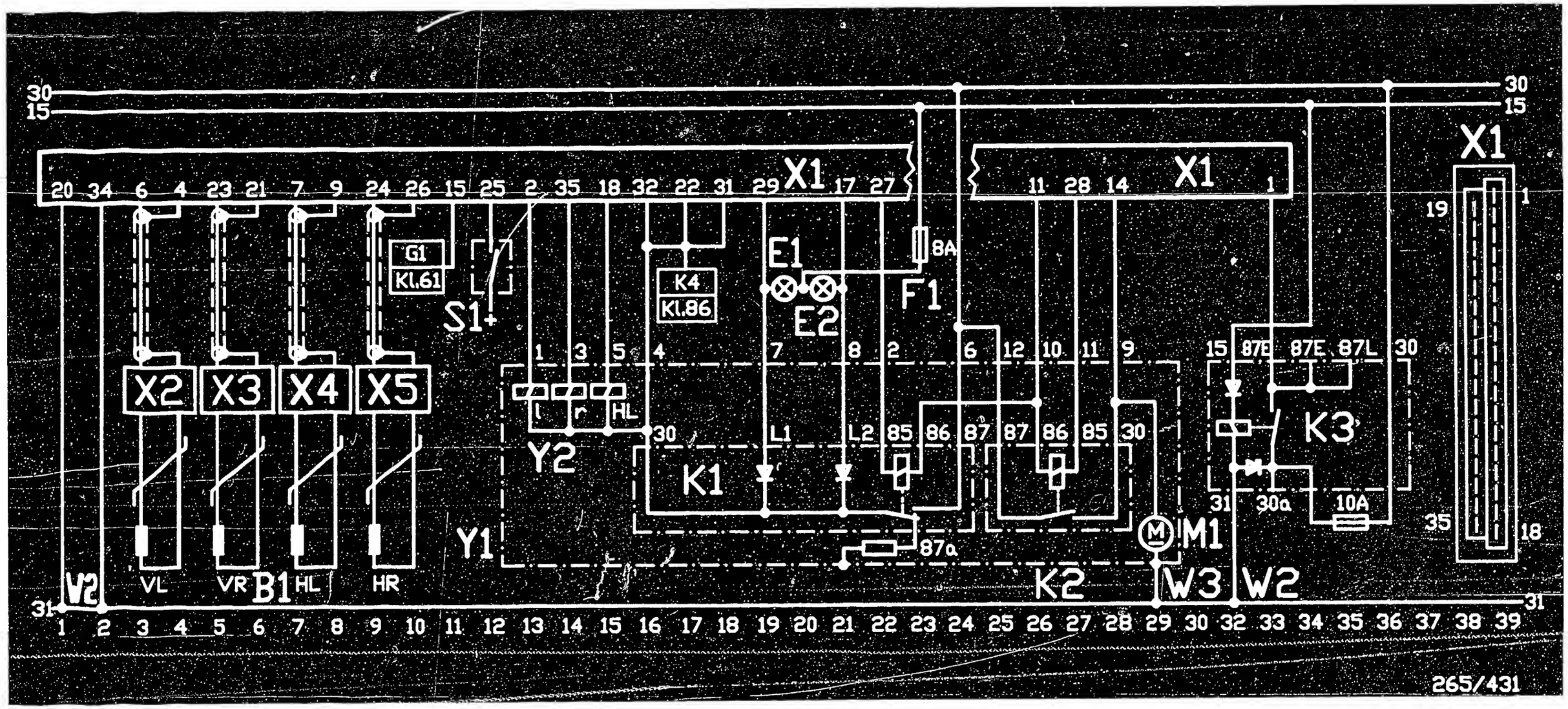
4. Removing pressure gauge.
   +Reduce pressure by means of bleeder screw (integrated into pressure tester).
   Caution! high pressure up to 200 bar possible!
   +Unscrew pressure gauge.
   +Reseal connection SP3 with bleeder screw.

5. Top up brake-fluid reservoir if necessary.

6. Start engine and leave running until accumulator is full. Subsequent charging possible.

Wheel-speed sensor	
* Winding resistance at ambient temperature (−10°C...+120°C) for	
front axle:	1000...2000 Ω
rear axle:	600...1600 Ω
ABS hydraulic-modulator solenoid-operated valves	
* Winding resistance at ambient temperature (−10°C...+120°C):	0,7...1,7 Ω
ASR hydraulic modulator	
* Solenoid-operated-valve winding resistance at ambient temperature (−10°C...+120°C) between term. 3 and term. 4:	0,7...1,7 Ω
* Winding resistance of change-over solenoid-operated valve at ambient temperature (−10°C und +120°C) between term. 2 and term. 4:	2...4 Ω
* Resistance between term. 1 and ground:	1400...1800 Ω
Air gap between air-speed sensor and ring gear	0,8 ± 0,5 mm
Tightening torque for	
* fastening screws of the front wheel-speed sensors:	6...8 Nm
rear wheel-speed sensors:	=> 8 Nm
* Brake-line connections at ABS/ASR components:	12...16 Nm
Number of teeth	
* Front axle:	48 teeth
* Rear axle:	48 teeth

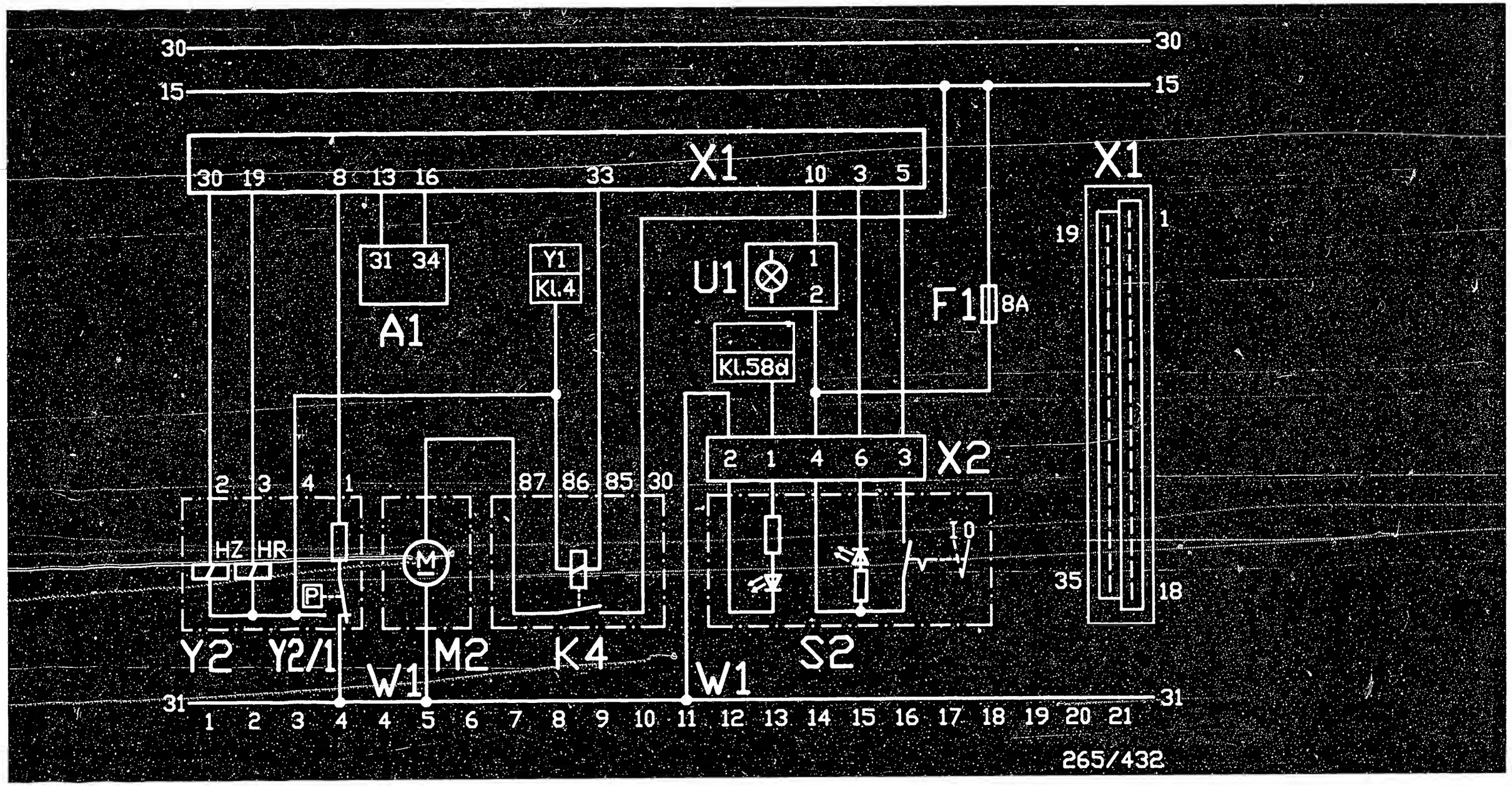
For production reasons: continued on the following coordinate.



B1 = Wheel-speed sensor
E1 = ABS warning lamp
E2 = ASR warning lamp
F1 = Fuse No. 7
G1 = To alternator term. 61/D+
K1 = Valve relay
K2 = Motor relay
K3 = Overvoltage-protection relay
M1 = Pump motor
S1 = Stop-lamp switch
X1 = ABS/ASR controller plug
Y1 = Hydraulic modulator
Y2 = Solenoid-operated valves
HL,HR = Rear left, rear right
VL(l),VR(r) = Front left, front right
W2 = Ground at battery
W3 = Ground at front left wheel house
X2, X3, X4, X5 = Wheel-speed-sensor plug-in connections

ELECTRICAL TERMINAL DIAGRAM

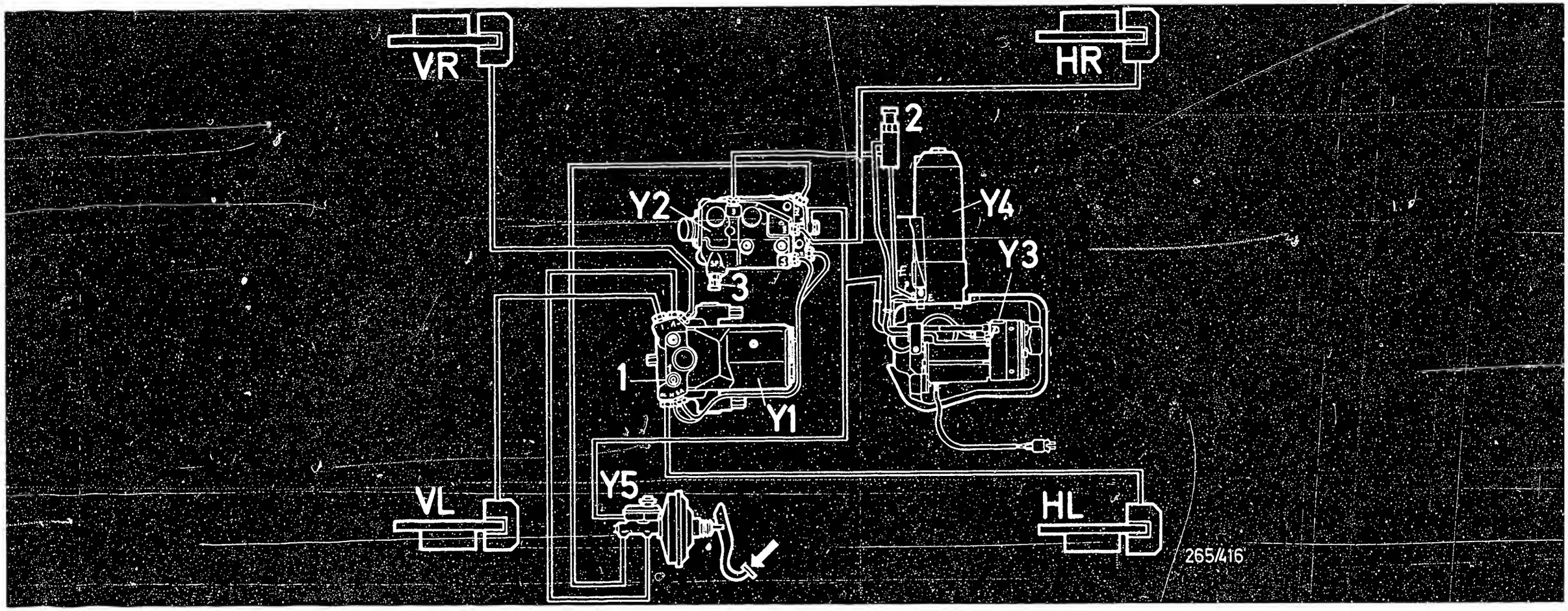
C11 —⟹
C12 ⟸—⟹



A1 = E Gas control unit
F1 = Fuse No. 7
K4 = Relay for charge pump
M2 = Charge pump
S2 = Snow-chains switch with indicator lamp
U1 = ASR function indicator in instrument cluster
W1 = Ground terminal behind instrument cluster

X1 = ABS/ASR controller plug
Y2 = ASR hydraulic modulator
Y2/1 = Pressure switch
Y2/HR = Solenoid-operated valve for rear right
Y2/HZ = Solenoid-operated valve with hydraulic connection to brake master cylinder

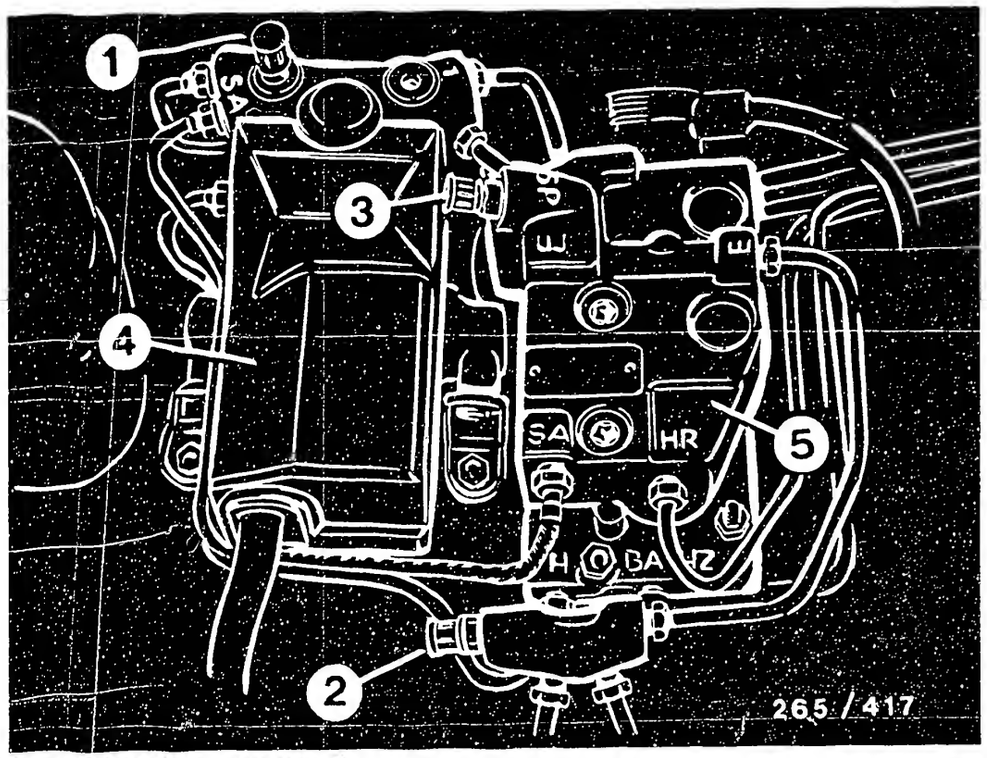
ELECTRICAL TERMINAL DIAGRAM



1 = Bleeder screw 1
2 = Bleeder screw 2
3 = Bleeder screw SP 3
BA = Reservoir connection
E = Accumulator connection
H = Rear axle
HL,HR = Rear left, rear right
HZ = Brake master cylinder (rear-axle circuit)
l,r = Left, right

P = Pressure connection
SA = Suction connection
V = Front-axle brake circuit
VL,VR = Front left, front right
Y1 = ABS hydraulic modulator
Y2 = ASR hydraulic modulator
Y3 = Charge pump
Y4 = Pressure accumulator
Y5 = Brake master cylinder with reservoir

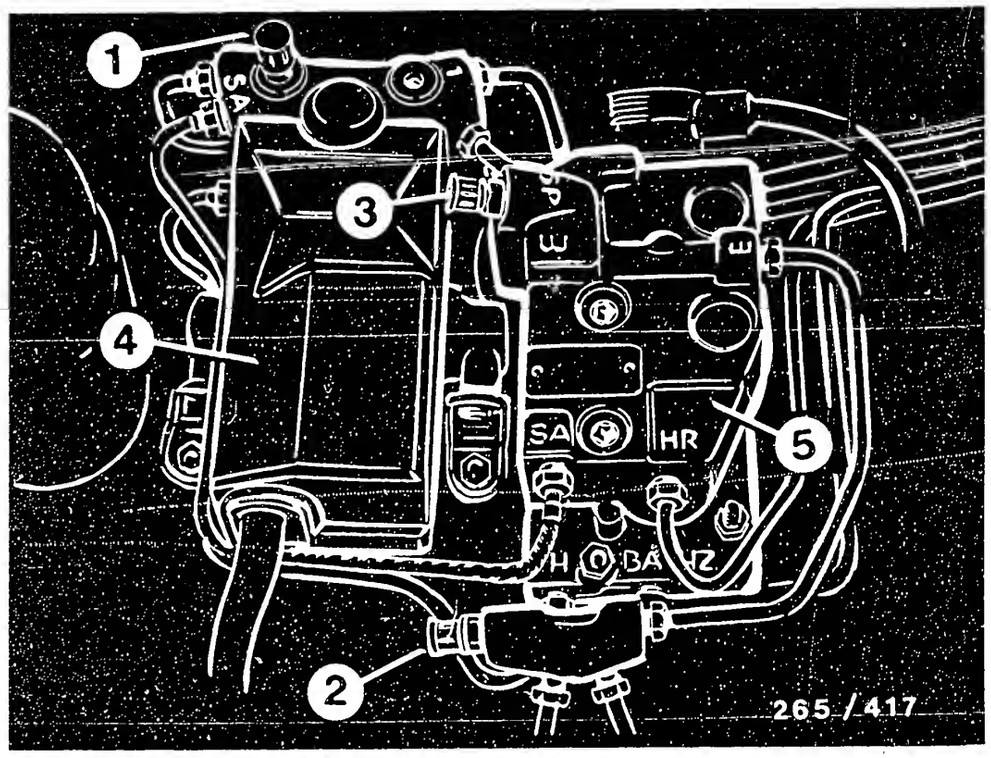
DIAGRAM OF HYDRAULIC CONNECTIONS



1 = Bleeder screw 1
2 = Bleeder screw 2
3 = Bleeder screw SP3
4 = ABS hydraulic modulator
5 = ASR hydraulic modulator

BLEEDING SPECIFICATIONS FOR ASR/DKB (DB)

Notes:
+ Bleed the system as usual after repairs to brake components on the wheel end.
+ After repairs at one wheel, bleed both sides.
+ The following bleeding procedure must be performed in full after exchange of hydraulic ABS/ASR components and the brake master cylinder.
+ After changing the brake fluid (annually), bleed the complete system.
+ Make sure you observe the sequence of bleeding steps.



1 = Bleeder screw 1
2 = Bleeder screw 2
3 = Bleeder screw SP3
4 = ABS hydraulic modulator
5 = ASR hydraulic modulator

BLEEDING SPECIFICATIONS (Continued)

1. Ignition off.
   Connect bleeding device as specified and apply pressure (approx. 2 bar) to reservoir.

2. Bleed the brake system as usual at the wheels.
   Bleed for approx. 1 minute at the rear right wheel.

3. Connect hose to bleeding connection 1 of ABS hydraulic modulator and dangle into a container.
   Open bleeding connection 1 until bubble-free brake fluid flows from the hose.

BLEEDING SPECIFICATIONS (Continued)

4. Empty the accumulator:
   Ignition off. Connect hose to bleeder screw SP3 on ASR hydraulic modulator and dangle into container.
   Open connection SP carefully and release pressure. Caution! High pressure up to 200 bar possible!

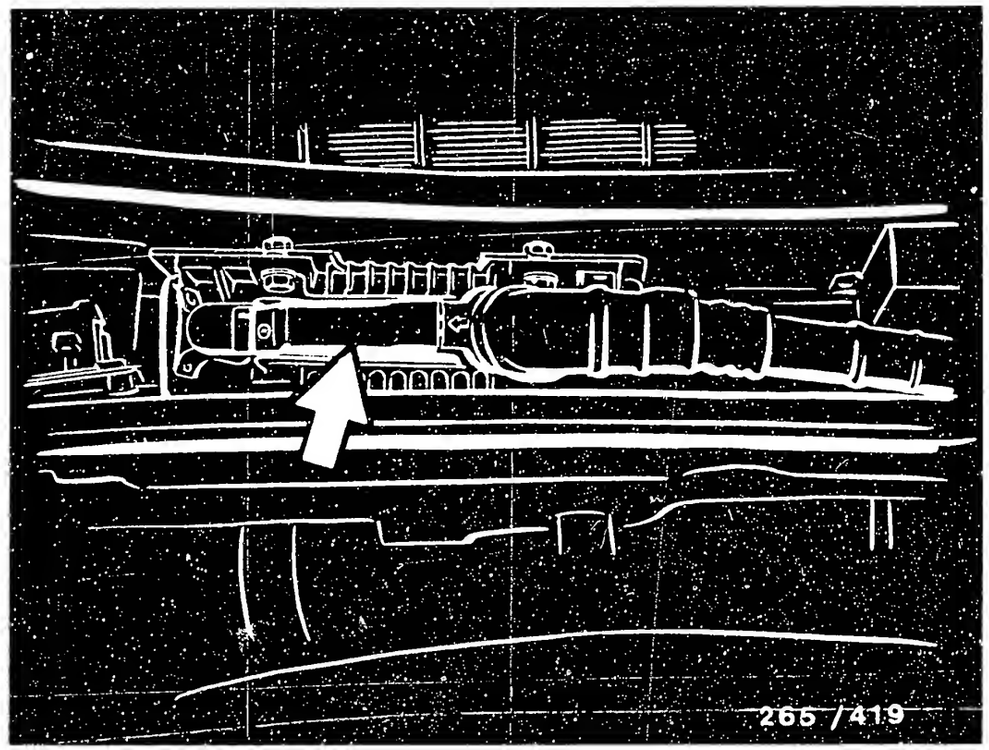
5. ABS/ASR controller must be connected.
   Run engine at idle.
   Connect hose to bleeder connection 2 and dangle into container.
   Open bleeder connection until bubble-free brake fluid flows out.

6. Continue running engine at idle.
   Connect hose to bleeder connection SP3 of the ASR hydraulic modulator and dangle into container.
   Open bleeder connection SP 3 carefully until bubble-free brake fluid escapes.
   Seal SP 3 and wait until accumulator is charged.
   Switch off ignition.
   Note! If bleeding takes a long time, the controller switches the charge pump off.
   No more brake fluid escapes and the ASR warning lamp lights up.
   Remedy: switch off engine and restart.
   Continue bleeding.

7. Remove bleeding device.

8. After the engine is started, the accumulator is subsequently charged if necessary.

9. Top up reservoir to Max. mark.

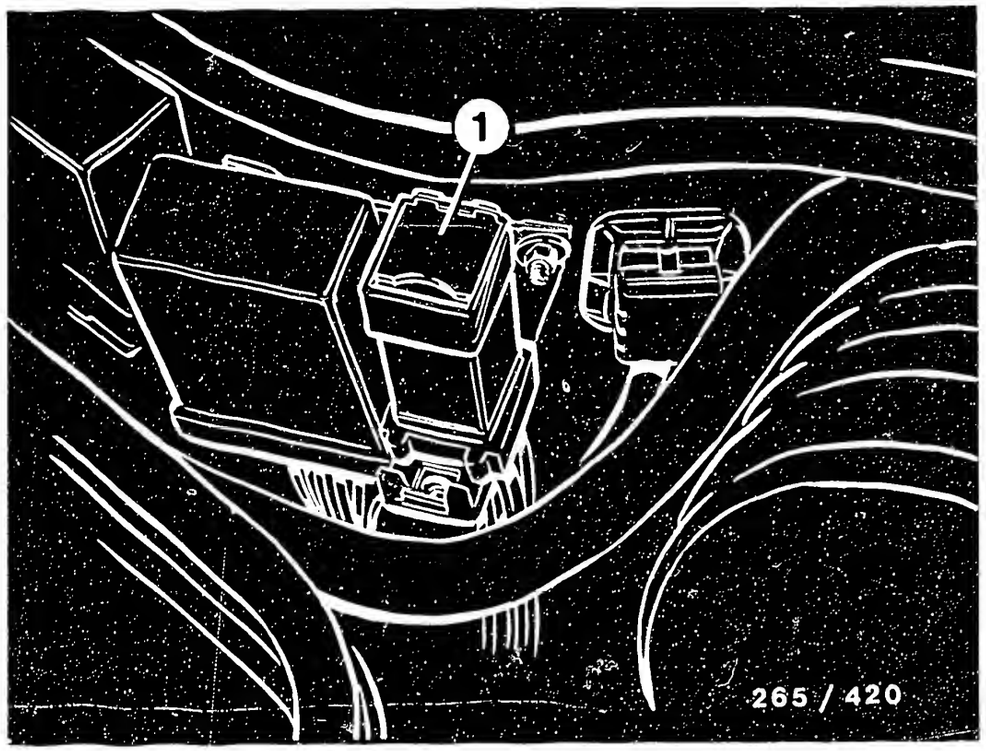


Arrow = ABS/ASR controller

INSTALLATION POSITION OF COMPONENTS

ABS/ASR controller (arrow):
Beneath the engine hood in the middle of the engine compartment.
Disconnect plug:
Loosen locking device and unhook plug at wiring-harness end from mechanical encoder.

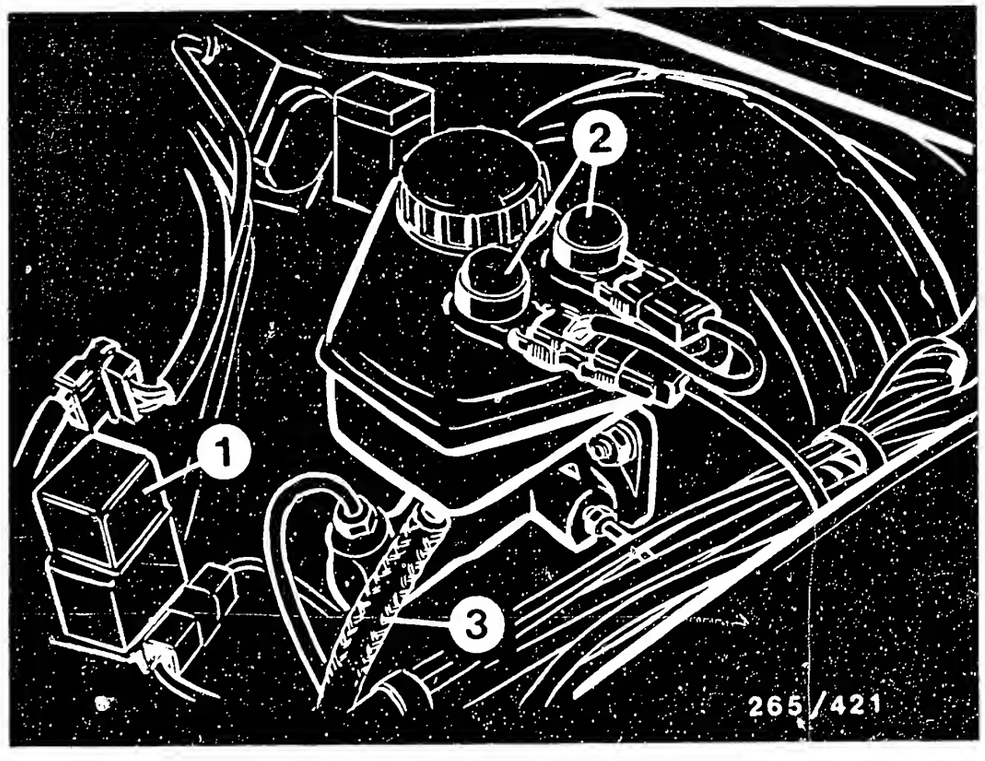
Ground terminals:
Behind the instrument cluster,
in the front left wheel house
and at the battery.



1 = Overvoltage–protection relay

INSTALLATION POSITION OF COMPONENTS (Continued)

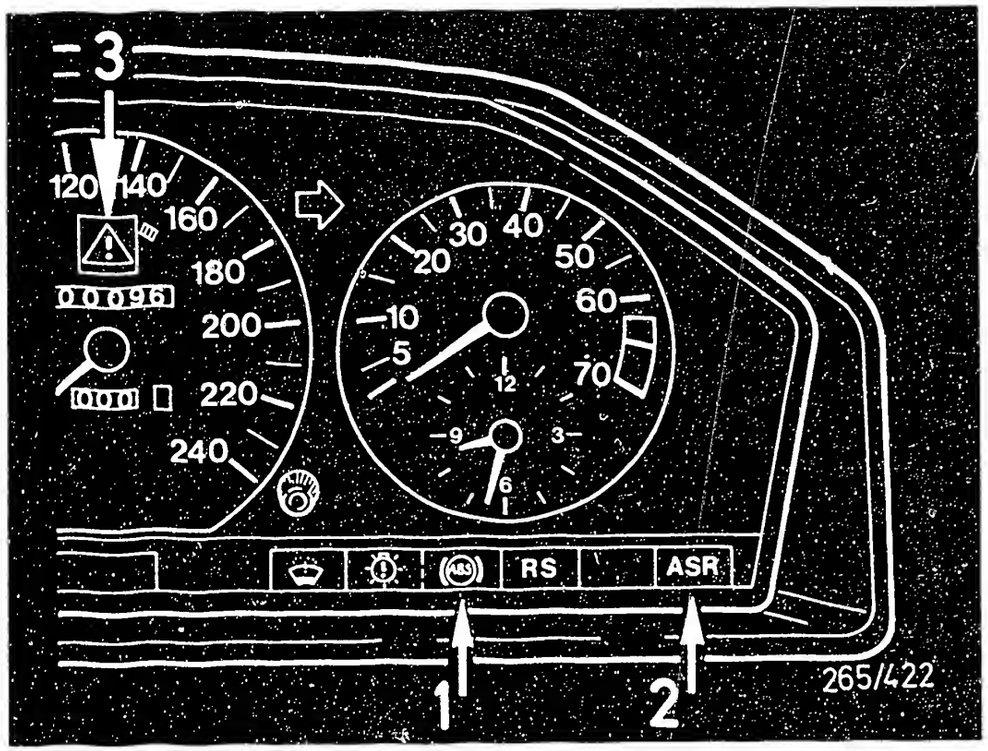
Overvoltage–protection relay:
In the engine compartment on the left.



1 = Relay for charge pump
2 = Switch for brake–fluid check
3 = Brake–fluid hose to charge pump

INSTALLATION POSITION OF COMPONENTS (Continued)

Relay for charge pump:
In the engine compartment on the left
on the bulkhead near to the brake–fluid reservoir.

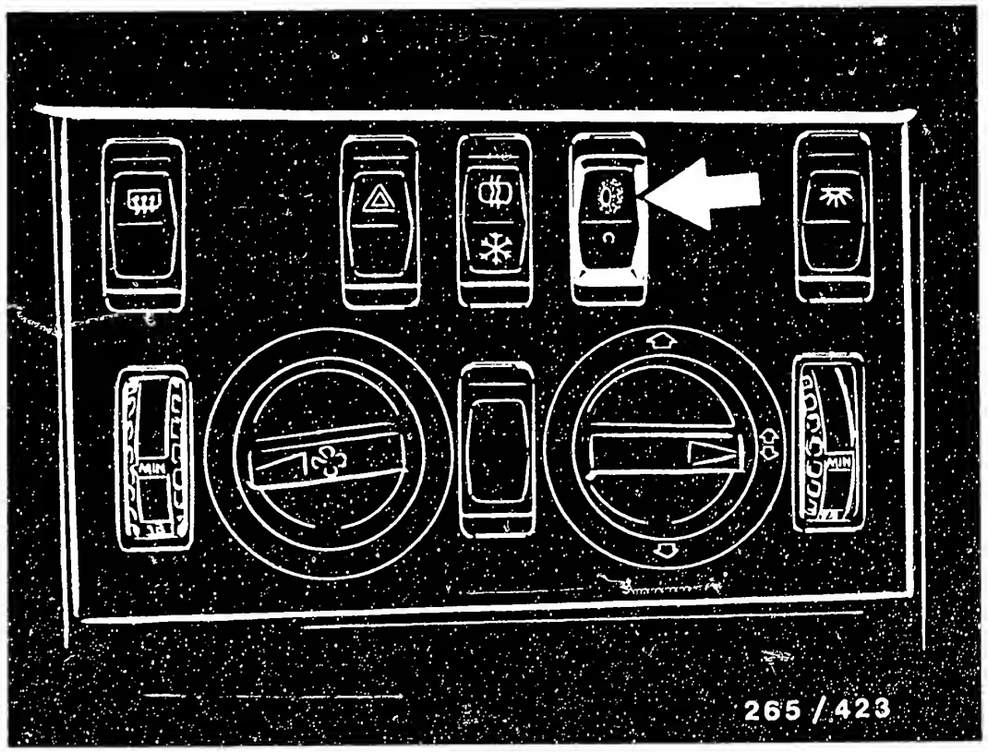


1 = ABS warning lamp
2 = ASR warning lamp
3 = ASR function indicator

INSTALLATION POSITION OF COMPONENTS (Continued)

ABS and ASR warning lamps:
In the instrument cluster at the bottom right.

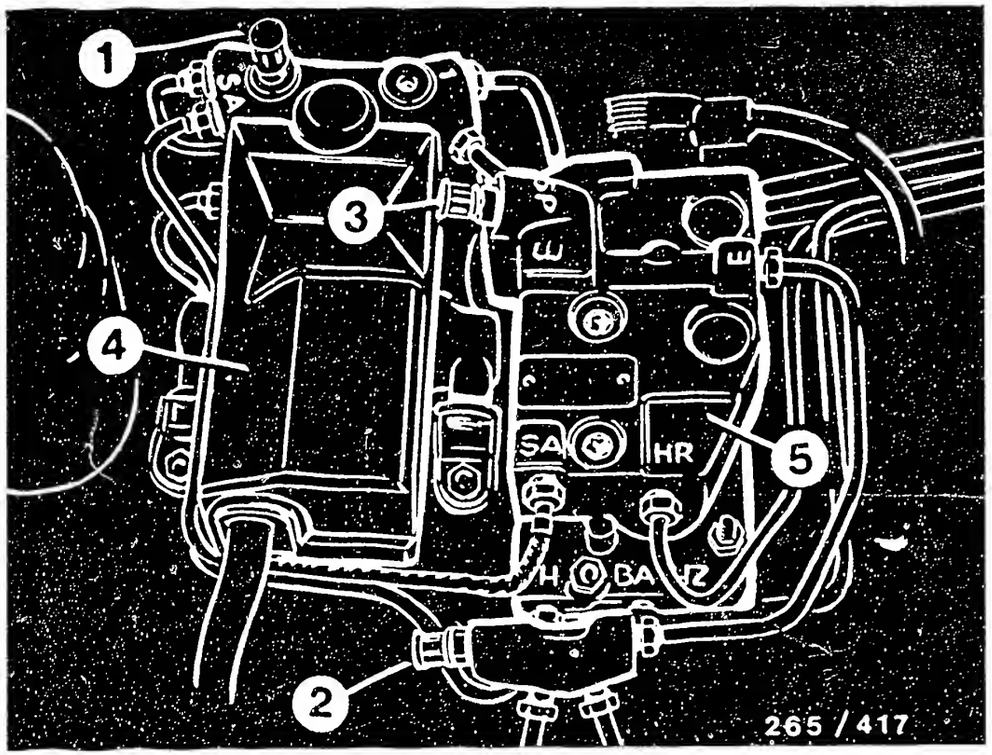
ASR function indicator:
In the speedometer at the top (warning triangle).



Arrow = snow-chains switch

INSTALLATION POSITION OF COMPONENTS (Continued)

Snow-chains switch with indicator lamp:
In the center console.



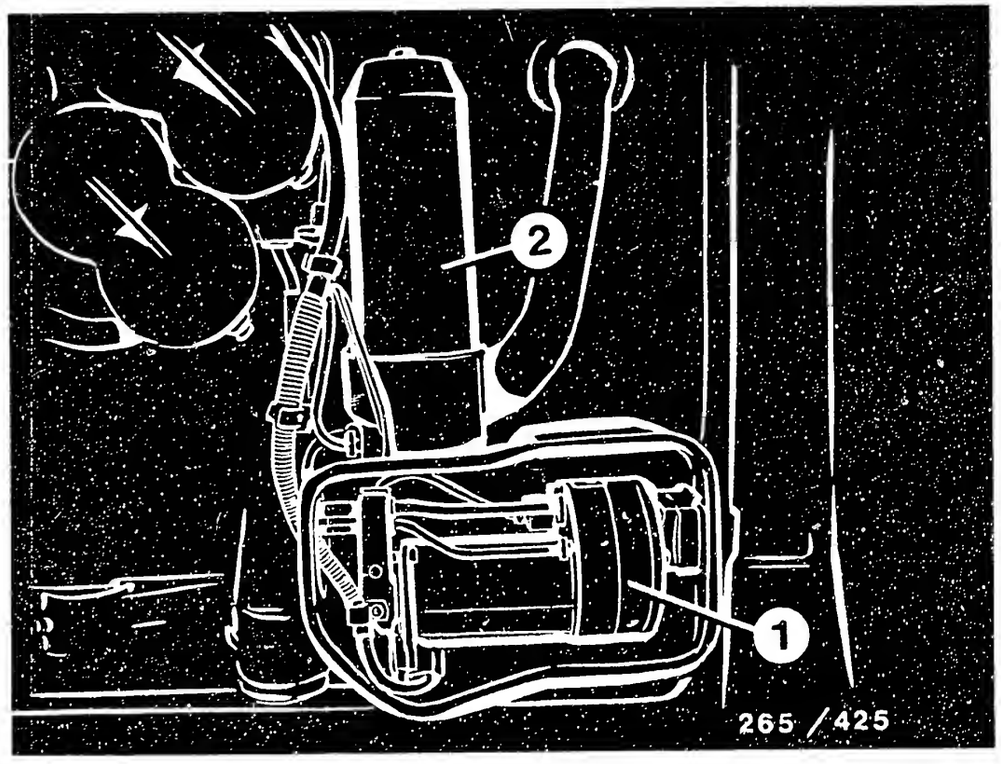
1 = Bleeder screw 1
2 = Bleeder screw 2
3 = Bleeder screw SP3
4 = ABS hydraulic modulator
5 = ASR hydraulic modulator

INSTALLATION POSITION OF COMPONENTS (Continued)

ABS and ASR hydraulic modulators:
In the engine compartment at the front on the left.

Hydraulic modulators must not be repaired but must be exchanged as complete units.
Exception: motor and valve relays.

Observe the bleeding specifications!



1 = Charge pump
2 = Pressure accumulator

INSTALLATION POSITION OF COMPONENTS (Continued)

Charge pump and pressure accumulator:
Under the front left fender behind a plastic covering.
Both components are mounted on a frame.
The frame is secured to the front end of the vehicle by means of anti-vibration pads.

Trouble-shooting instructions : VWW-5006

BOSCH system : L2 - Jetronic-Jetronic

Make of vehicle : VW

Basic microcard : VWW-503

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Special features	02
Structure, usage	03
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Installation position of components	13

SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle model with 1.272 l/4-cyl. engine:

VW Polo Injection 4.87 ->
Engine identification code SC

* L2-Jetronic with 25-pin control unit: 0 220 000 545/546
* Engine-speed triggering from term. 7 of the TCI trigger box
* 4-pin air-flow sensor
* Solenoid-operated injection valves with brass-wire coil.
* Start control
* Throttle-valve switch with double dog for idle and full load
* In-tank pre-supply pump
* For testing the fuel pressure, interconnect pressure tester with connecting piece KDJE-P 100/13 at the fuel-distribution-pipe inlet.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel when testing the compression.
To ensure this, disconnect pump relay.

For further precautionary measures, see brief instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, fuel injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*		*		Universal test adapter
*											Electric fuel pump
*	*	*	*								Auxiliary-air device/idle actuator
*	*	*	*	*	*	*	*				Air-flow sensor/air-mass sensor
*	*	*	*		*						Intake system
		*	*	*		*	*				Solenoid-operated injection valves
*	*	*			*	*					Fuel pressure
				*	*						Fuel quantity
		*	*	*	*	*					Throttle valve
				*							Overrun cut-off
*		*									Start control
				*							Ground
*	*	*	*	*	*						Alternator, interference suppress.
		*	*	*		*					CO exhaust-gas adjustment
				*							Control unit

RAPID DIAGNOIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter cable: 1 684 463 156

Test step	Switch V	Switch Ω	Terms.	Inspection of component/function	Test instructions/ Test conditions	Set values
1	4	–	21 – 7 (+) (–)	Voltage from ignition and starting switch term. 50	Disengage gear, start engine	8...15 V
2	5	–	1 – 7 (+) (–)	TD signal from TCI trigger box term. 7	Disengage gear, start engine	Ignition pulses on oscilloscope
3	6	–	13 – 7 (+) (–)	Voltage from main relay term. 87	Ignition "ON"	8...15 V
4	7	–	20 – 7 (+) (–)	Voltage from pump relay term. 86	Ignition "ON"	8...15 V
5	| V	5	2 – 7	Resistance, temperature sensor (engine)	+15...+30°C: approx. +80°C :	1,3...3,6 k Ω 250...390 Ω
6	| V	6	14 – 7 (6)	Resistance, temperature sensor (intake air)	+15...+30°C: approx. +80°C :	1,3...3,6 k Ω 250...390 Ω
7	| V	7	15 – 7 (6)	Resistance of potentio-meter in air-flow sensor	Deflect air-flow sensor flap to the stop	8...1000 Ω
8	| V	8	19 – 7 (6)	Resistance in air-flow sensor		500...800 Ω
9	| V	9	4 – 7	Resistance of throttle-valve switch	Accelerator pedal in rest position: Accelerator pedal slightly depressed: Accelerator pedal fully depressed:	0...10 Ω Infinity Ω 0...10 Ω

D05 — ⟹

D06 — ⟺

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter cable: 1 684 463 156

Test step	Switch V	Switch Ω	Terms.	Inspection of component/function	Test instructions/ Test conditions	Set values
10	| V	11	25 - 7	Ground connection of output stage		0...10 Ω
11	| V	12	12 - 7	Resistance of 1st injection valve and electric fuel pump	+15...+30°C : Approx. +80°C :	17,7...22 Ω 19,7...24,5 Ω
12	| V	13	11 - 7	Resistance of 2nd injection valve and electric fuel pump	+15...+30°C : Approx. +80°C :	17,7...22 Ω 19,7...24,5 Ω
13	| V	14	24 - 7	Resistance of 3rd injection valve and electric fuel pump	+15...+30°C : Approx. +80°C :	17,7...22 Ω 19,7...24,5 Ω
14	| V	15	23 - 7	Resistance of 4th injection valve and electric fuel pump	+15...+30°C : Approx. +80°C :	17,7...22 Ω 19,7...24,5 Ω

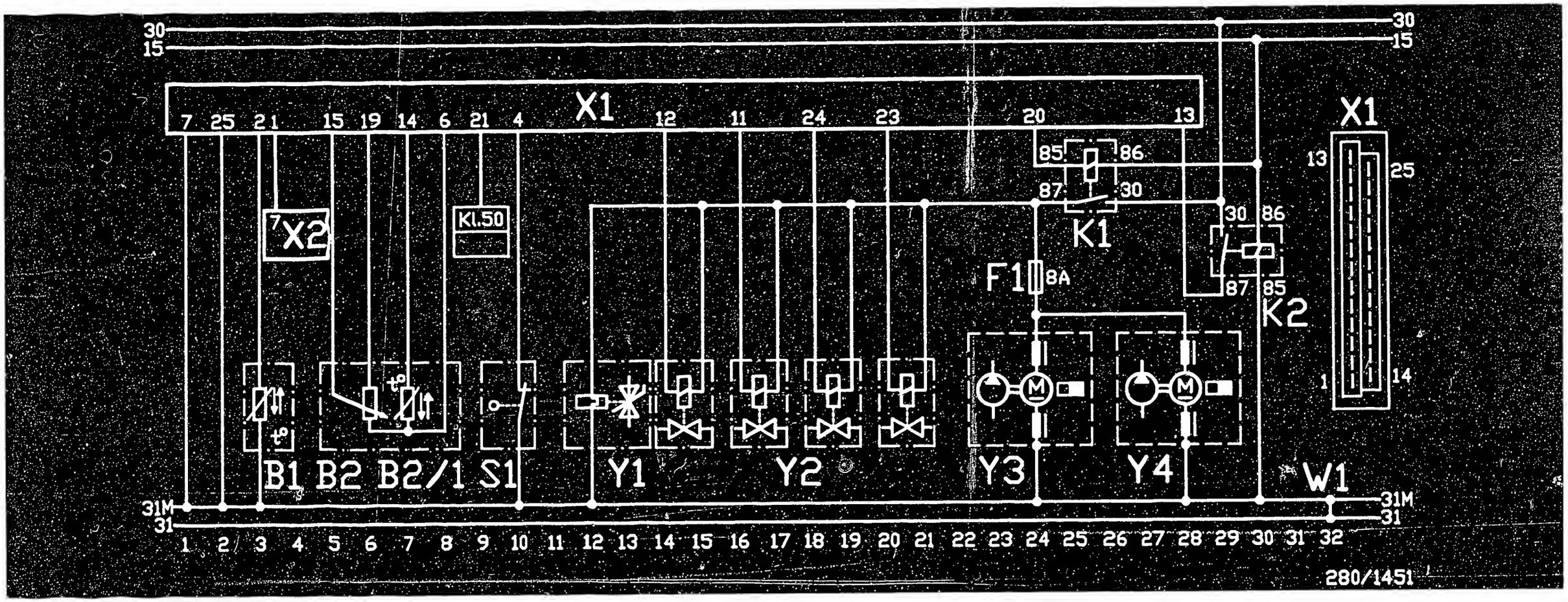
TEST SPECIFICATIONS

Component/function	Set values
Electric fuel pumps	
* Fuel delivery at return:	min. 500 cm ^{3} /30 s
* Supply voltage under load:	min. 12 V
* Fuel delivery of in-tank pre-supply pump	min. 600 cm ^{3} /30 s
Pressure regulator	
* Fuel pressure with engine at standstill:	2,3...2,7 bar
at idle:	approx. 0.5 bar lower
Fuel system, leakages	
* Fuel pressure after engine stationary for 20 min.:	min. 1.0 bar
Auxiliary-air device	
* Resistance value	25... 60 Ω
Air-flow sensor	
* Resistance value between	
term. 2 and term. 4:	8...1000 Ω 1)
term. 3 and term. 4:	500... 800 Ω
1) (Fully deflect air-flow sensor flap)	
Temperature sensor (engine)	
* Electrical internal resistance at ambient temperature	
+15...+30°C:	1,3...3,6 k Ω
with eng. at op. temperature approx. +80°C :	250...390 Ω

TEST SPECIFICATIONS (Continued)

Component/function	Set values
Temperature sensor (air intake)	
* Internal electrical resistance at ambient temperature	
+15...+30°C:	1,3...3,6 k Ω
With engine at norm. op. temp. approx. +80°C :	250...390 Ω
Solenoid-operated injection valve	
* Internal electrical resistance at ambient temperature	
+15...+30°C:	14.5...17.5 Ω
* Leakage after 60 s:	No drop must fall
Start control	
* Voltage at injection valve	
on initiation of starting:	greater 1.5 V
after approx. 15 s:	approx. 0.5 V
Idle adjustment	
Engine at norm. op. temp. approx. +80°C	
* Idle speed:	750...850 min $^{-1}$
* CO content: Measuring point: at the exhaust pipe on the left. If necessary, use VW adapter V.A.G. 1506	% by vol. 1,0...2,0

See equipment and Autodata microcards for the settings for ignition, valve clearance and other engine-related data.



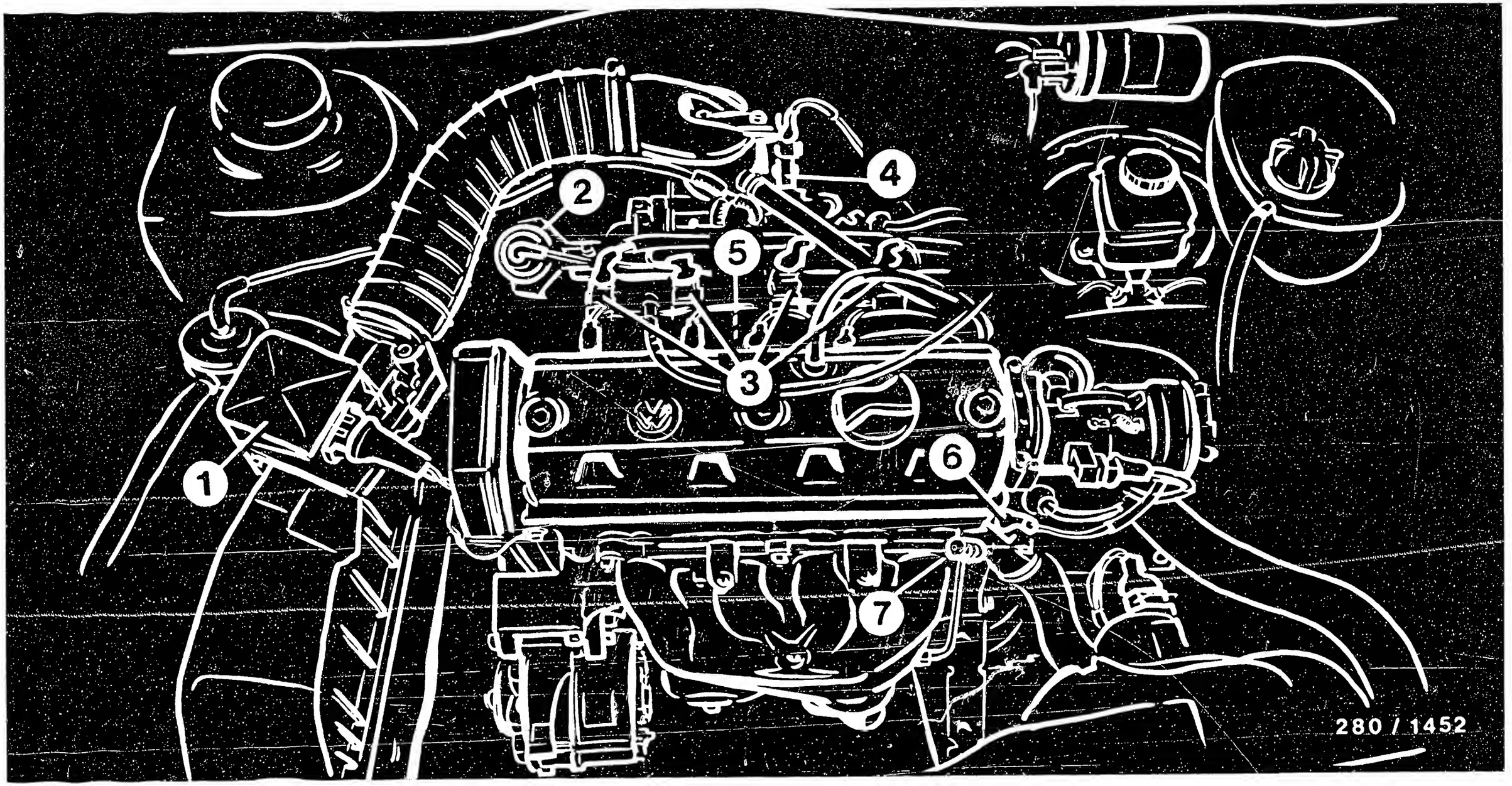
B1 = Temperature sensor (engine)
B2 = Air-flow sensor
B2/1= Temperature sensor (air intake)
F1 = Fuse (electric fuel pump)
K1 = Pump relay
K2 = Main relay
S1 = Throttle-valve switch

W1 = Ground strap, engine
X1 = Control-unit plug
X2 = Ignition control-unit plug
Y1 = Auxiliary-air device
Y2 = Solenoid-operated injection valves
Y3 = In-tank electric fuel pump
Y4 = In-tank pre-supply pump

ELECTRICAL TERMINAL DIAGRAM

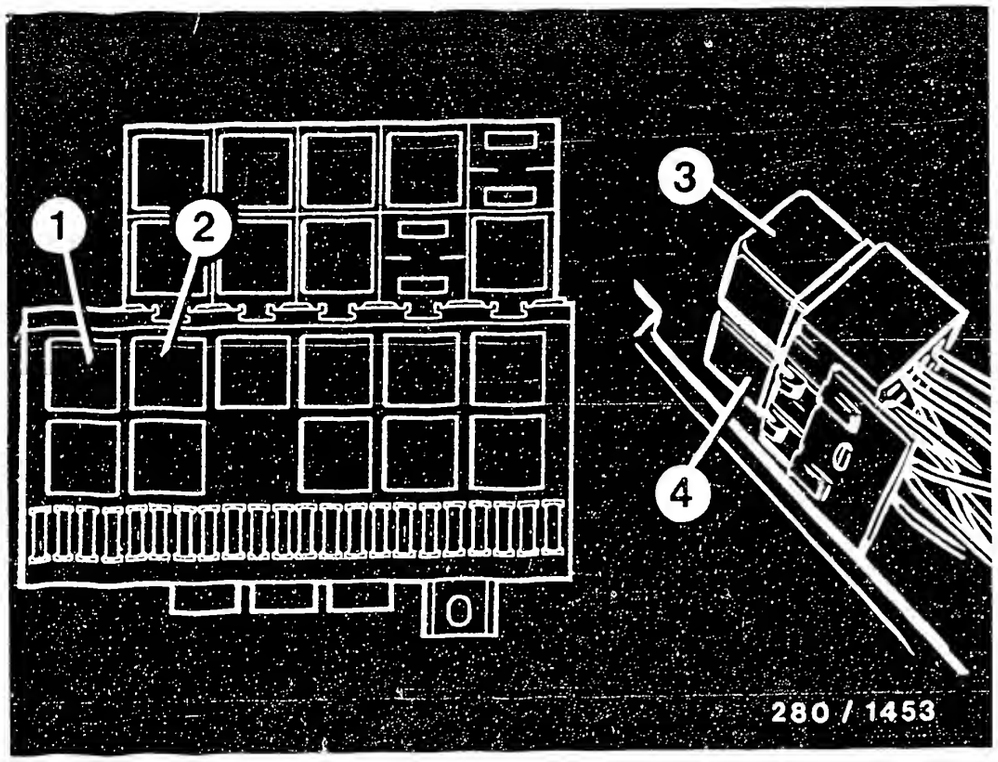
D11 ⟹

D12 ⟸



INSTALLATION POSITION OF COMPONENTS

1 = Air-flow sensor
2 = Pressure regulator
3 = Solenoid-operated injection valves
4 = Throttle-valve switch
5 = To auxiliary-air device
6 = Temperature sensor (engine)
7 = CO sample pickup



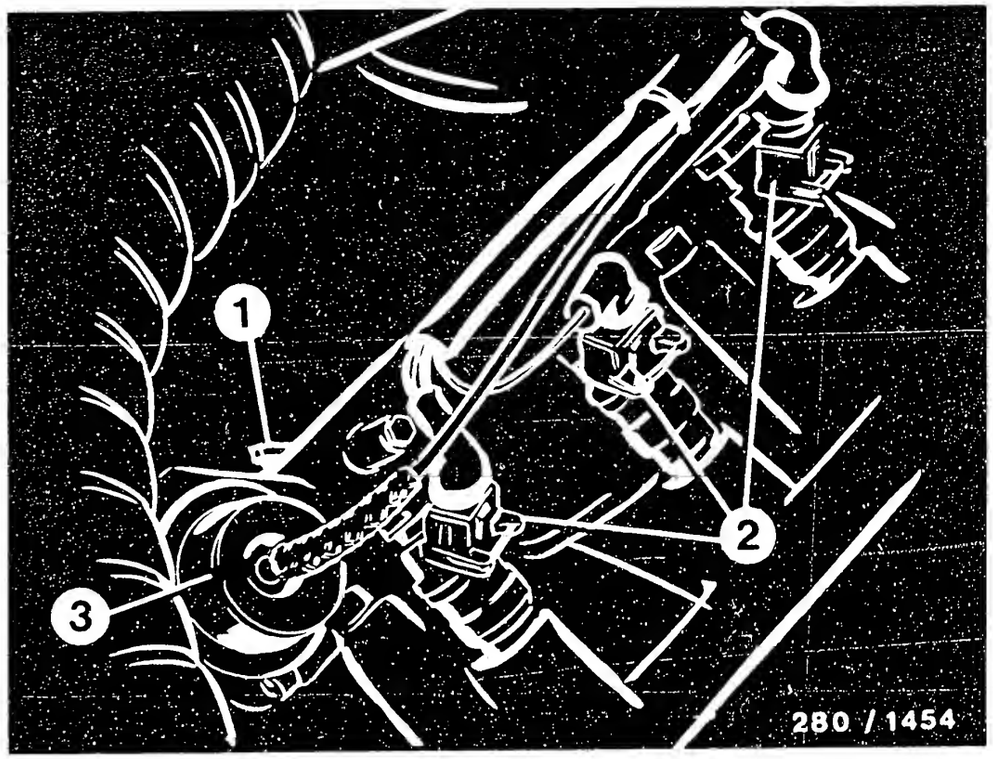
1 = Main relay
2 = Pump relay
3 = Pump relay (Polo)
4 = Main relay (Polo)

All details of installation positions always refers to the forward direction of travel.

In the Golf model both relays are located on the left at the bottom on the driver's side.
In the Polo model both relays are located on the left at the front in the radiator tank, in the vicinity of the control unit.

Other components not shown

* Lambda sensor is screwed into exhaust pipe upstream of catalytic converter.



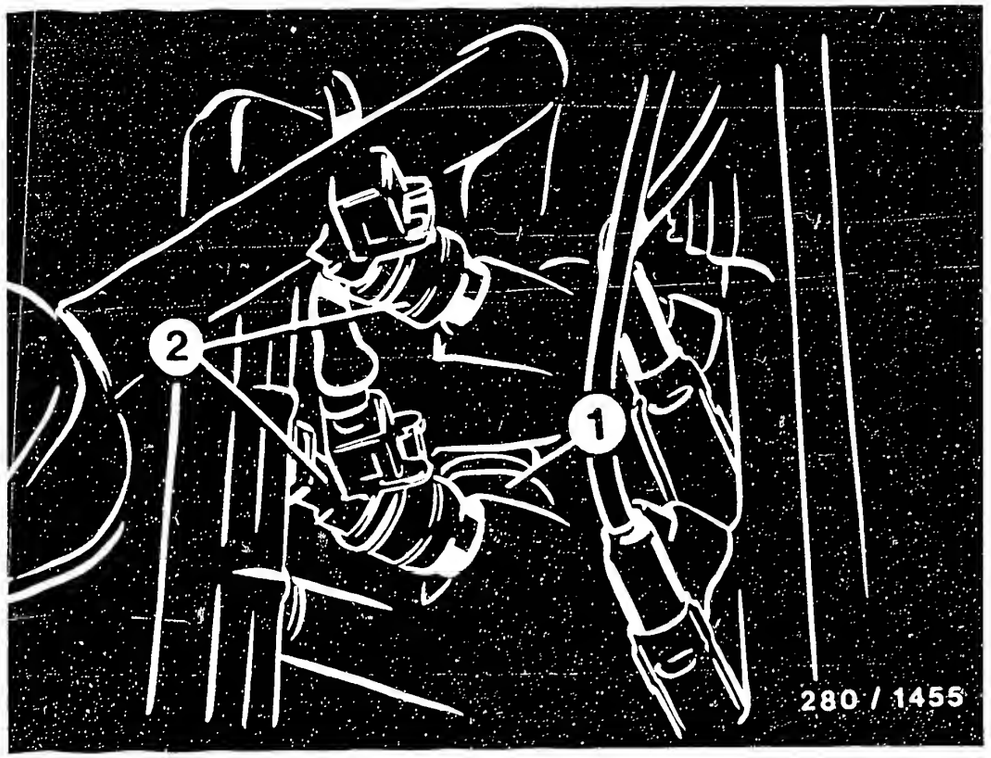
1 = Pressure-measuring connection
2 = Solenoid-operated injection valves
3 = Pressure regulator

FUEL-PRESSURE TEST

To test pressure, use pressure gauge and hose of pressure-measuring device KDJE-P 100.

Insert connecting piece KDJE-P 100/13 at fuel-distribution-pipe inlet and connect hose to pressure gauge at lateral threaded connector.

Caution. When opening the screw connection take care that no fuel comes into contact with hot engine parts.



1 = Auxiliary-air device
2 = Solenoid-operated injection valves

Other components not shown

* Electric fuel pump, in Golf model as in-tank pump, is located in pump accumulator on the right at the bottom in front of the rear axle.

* In-tank pre-supply pump in Golf model is combined with tank indicator and accessible via a cover above the fuel tank.

* Electric fuel pump in Polo model is located on the right at the bottom behind the rear axle.

* In-tank pre-supply pump in Polo model is fitted in same position as in Golf model.

* Central ground is connected to the ground terminal of the battery.

For production reasons:
continued on the following coordinate.

Trouble-shooting instructions : VWW-5007

BOSCH system : Motronic (Digifant)

Make of vehicle : Volkswagen

Basic microcard : PKW-046

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Section	Coordinates
Special features	02
Trouble-shooting chart	05
Rapid diagnosis chart	07
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Electrical terminal diagram	19
Installation position of components, notes on removal and installation	21

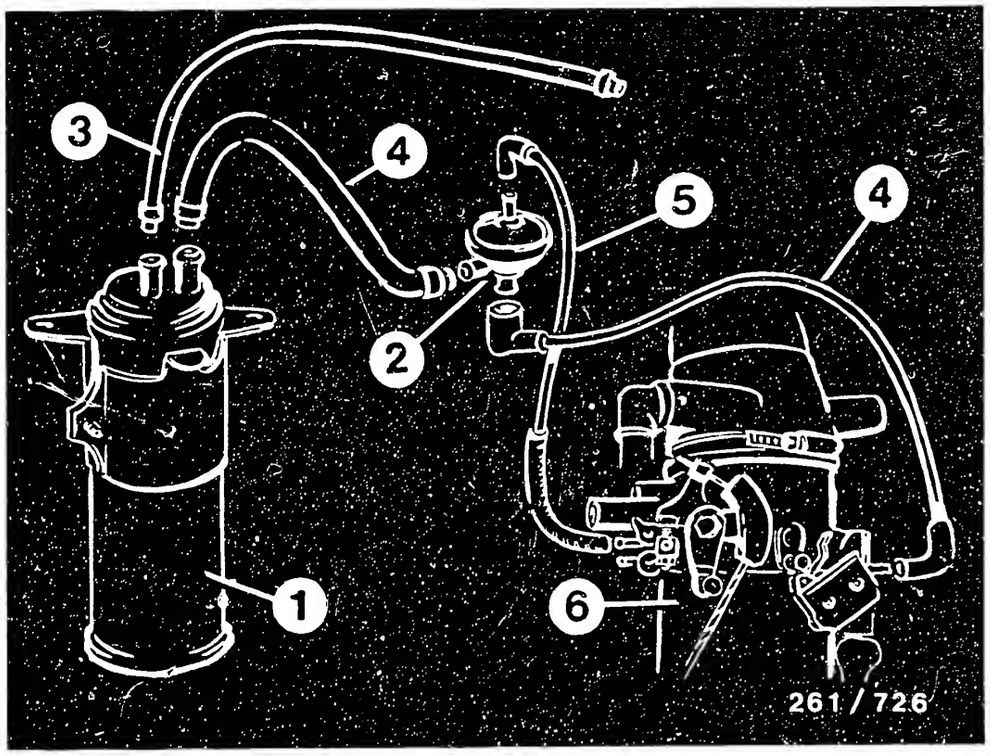
SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following vehicle models:

* VW Golf, Jetta (03.87 ->)
  with 1.8 l / 4-cyl. engine
  with and without catalytic converter

Special features:

- 79 kW (107 bhp) engine, identification code "PF" with catalytic converter (without and with lambda sensor)
- 82 kW (111 bhp) engine, identification code "PB" without catalytic converter
- 77 kW (104 bhp) engine, identification code "RV" (US version)
- Crankshaft rotational speed and position is detected by means of "Hall generator" (engine-speed and reference-mark sensors not fitted)
- Control unit with 25-pin connector
- Low-idle-speed control
- Knock control



1 = Activation-carbon canister
2 = Tank-ventilation valve
3 = Tank-ventilation line
4 = Scavaging line (suction hose)
5 = Activating line
6 = Throttle-valve assembly

SPECIAL FEATURES (CONTINUED)

Tank-ventilation system:
Lambda closed-loop-control vehicles are equipped with a closed tank-ventilation system. The gasoline vapors produced in the fuel tank are fed through the tank-ventilation line into the activated-carbon canister. From here, the fuel vapors go into the activated-carbon charge.
The tank-ventilation valve has the task of feeding the gasoline vapors stored in the activated-carbon canister to the combustion chamber when a vehicle is being driven.
When the engine is at standstill or at idle, the tank-ventilation valve closes the scavaging line. When the engine speed is increased, the tank-ventilation valve opens.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel and high-voltage flashovers when testing the compression.
  Therefore, disconnect main relay.

TROUBLE-SHOOTING CHART

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, fuel injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*											Voltage at control unit
*			*								Magnetic pulse generator
*		*			*	*					Fuel pressure
			*	*							Fuel delivery
*		*				*	*				Solenoid-operated injection valves
		*			*						Throttle valve
		*	*		*						Throttle-valve switch
		*									Overrun cut-off
	*	*	*								Idle actuator
		*									Idle speed, CO
*	*	*	*								Air-intake system
*	*	*	*	*	*	*					Air-flow sensor
					*	*					Air-intake temperature sensor
*	*	*	*	*	*	*					Temperature sensor (engine)
			*		*	*		*			Knock sensor
*		*		*	*						Ignition coil
*		*	*	*	*						Primary signal
		*	*	*	*	*					Secondary pattern
*	*	*	*		*	*	*	*	*		Spark-advance angle
		*	*	*							Interference-suppression resistors
				*	*						Interference
	*	*	*				*				Tank ventilation
		*	*								Lambda closed-loop control
*	*	*	*	*	*	*		*	*		Control unit

E05 —— => <=

For production reasons: continued on the following coordinate.

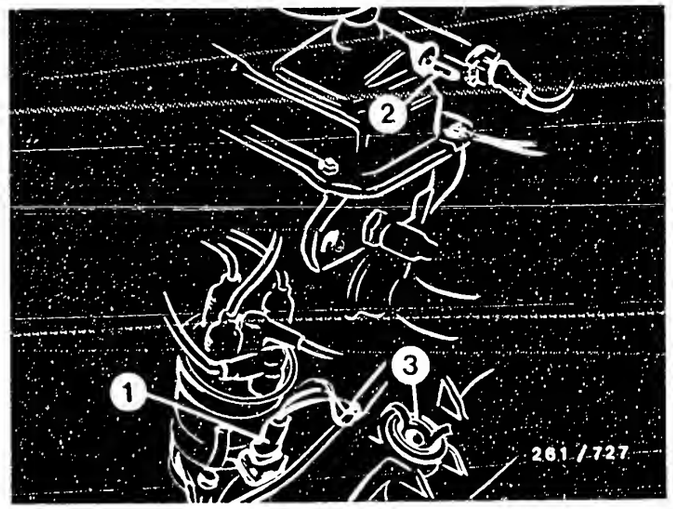
E06 —— => <=

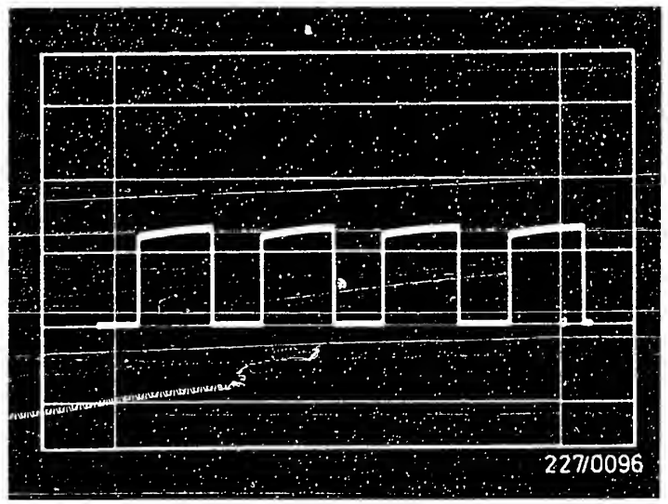
RAPID DIAGNOSIS CHART

Test step	Testing of component/function	Test instructions/ Test conditions	Ctrl.-unit term-inals	Set values
1	Leads to magnetic pulse generator (Hall generator)	Shift into neutral, switch off ignition, disconnect Digifant control unit and control unit of the low-idle-speed control, as well as the pump relay. Disconnect the plug from the ignition distributor and bridge all three connections. Measure resistance using test prods at the open control-unit plug (25-pin). Caution – do not damage spring contacts!	8<=> 6 and 18<=> 6	Approx. Ω (continuity)
2	Air-intake temperature sensor	Resistance at +15...+30°C:	9<=> 6	1,45...3,30 k Ω
3	Coolant-temperature sensor	Resistance at +15...+30°C: with engine at normal operating temperature:	10<=> 6	1,45...3,30 k Ω 280...360 Ω
4	Throttle-valve switch, idle contact	Do not depress accelerator pedal: Depress accelerator pedal slightly (part-load range):	11<=> 6	Approx. 0 Ω (continuity) Greater than 1 M Ω
5	Full-load contact	Depress accelerator pedal to floor (full-load stop): Ease off accelerator pedal slightly:	11<=> 6	Approx. 0 Ω (continuity) Greater than 1 M Ω
6	Air-flow sensor (Overall resistance)	Measure resistance:	17<=> 6	500...1100 Ω
7	Air-flow sensor (wiper)	Deflect air-flow-sensor flap slowly as far as it will go:	21<=> 6	8...2500 Ω
8	Injection valves (4)	Winding resistance at +15...+30°C: Note: all valves parallel	12<=>14	3,7...5,0 Ω
9	Lead to lambda sensor	Pull apart lambda-sensor plug-in connection: Apply lambda input (green lead to control unit) to ground:	2<=>13	Greater than 1 M Ω Approx. 0 Ω (continuity)
10	Heater winding of lambda sensor	Measure resistance:	14<=>13	0 Ω (temperature-dependent)

RAPID DIAGNOSIS CHART (Continued)

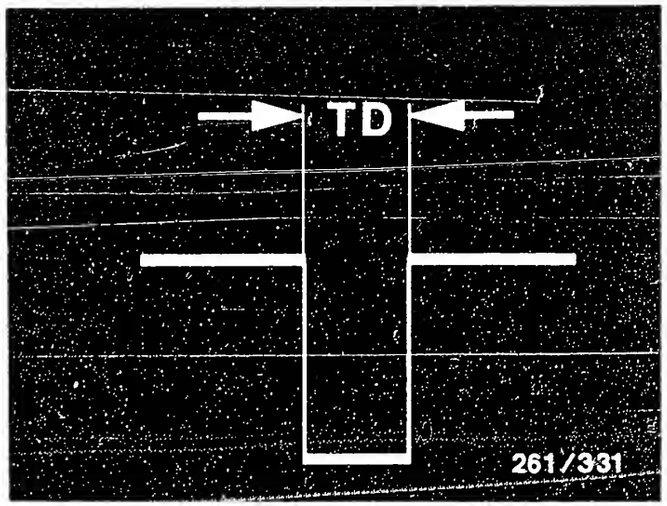
Test step	Testing of component/function Test instructions/conditions	Ctrl.-unit term-inals	Set values
11	Voltage measurement, switch over measuring range Main relay + supply leads; voltage supply of control unit. Switch on ignition:	14, 13 and 14, 19	10...15 V
12	Pump relay + supply leads; activation of electric fuel pump. Switch on ignition:	3, 13	10...15 V
13	Fuel pressure Switch off ignition, connect pressure gauge: -to fuel-distribution pipe, if V.A.G 1318/1 adapter fitted (upper illustration Item 2) or -to fuel inlet with Y connecting piece (center illustration, arrow). Switch on ignition, bridge term. 3 and term. 13 in the control-unit plug. Electric fuel pump must start to run audibly:	———	2,8...3,2 bar
14	Lead to term.50 (starting motor). Start signal. Shift into neutral and start:	1, 13	8...15 V
15	Ignition coil (primary winding) with supply leads, as well as connection from control unit term. 25 to ignition trigger box term. 6 (bridge term. 6 and term. 1 in 7-pin plug). Switch on ignition:	25, 13	10...15 V
16	Digifant control unit. Supply voltage of magnetic pulse generator. Connect control unit, push back rubber sleeve of plug on ignition distributor (upper illustration Item 1). Measure voltage at the two outer leads (+ and -) using test prods. Switch on ignition:	8, 6	10...15 V
17	Magnetic pulse generator, switching. As previously, however, test the voltage characteristic using oscilloscope (special input at the center connection (0) and vehicle ground. Start engine:	18, 6	See lower illustration

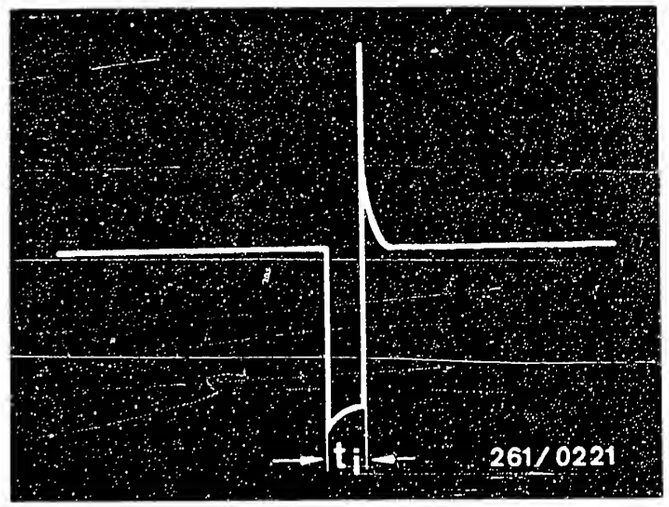


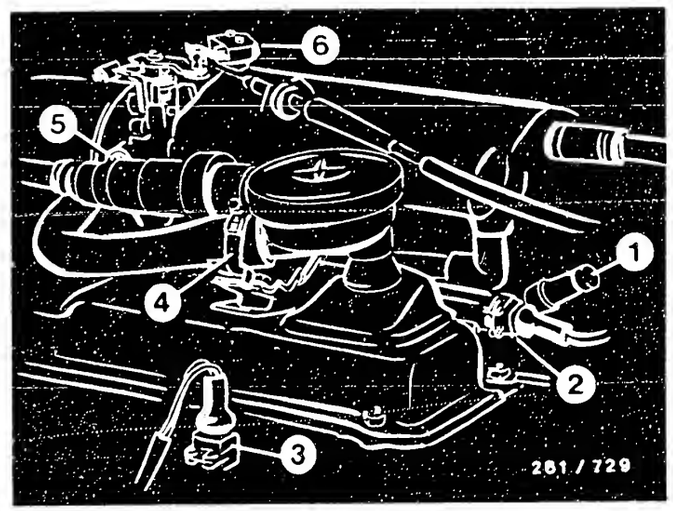


RAPID DIAGNOSIS CHART (Continued)

Test step	Testing of component/function Test instructions/conditions	Ctrl.-unit ter-minals	Set values
18	Dwell-period signal Using oscilloscope (special input), test at ignition trigger box term. 6 and term. 2 (push back rubber sleeve). Shift into neutral and start.	25, ground	See upper illustration
19	Injection signal Using oscilloscope, test at common injection-valve plug (lower illustration, Item 2) (test lead 1 684 463 093). Shift into neutral and start.	14, 12	See center illustration
20	Voltage supply of air-flow sensor Push back rubber sleeve on air-flow-sensor plug and measure voltage between terminals 3 and 4 using test prods. Swith on ignition.	17, 6	Greater than 4,5 V
21	Air-flow sensor (wiper) As above, however, measure between terminals 2 and 4.	21, 6	Air-flow-sensor flap in rest position: 0,2...0,3 V Deflect air-flow-sensor flap fully: greater than 4,2 V
22	Overrun cut-off Start engine, increase engine speed to approx. 2000 min. $^{-1}$ and actuate full-load contact (lower illustration, Item 6) or idle contact (both contacts connected in parallel).	———	Engine (at normal operating temp.) hunts
23	Leads to knock sensor Pull apart plug-in connection to knock sensor and bridge all three connections in the plug. Measure resistance in the control-unit plug:	5, 4 and 7, 4	Approx. 0 Ω (continued)

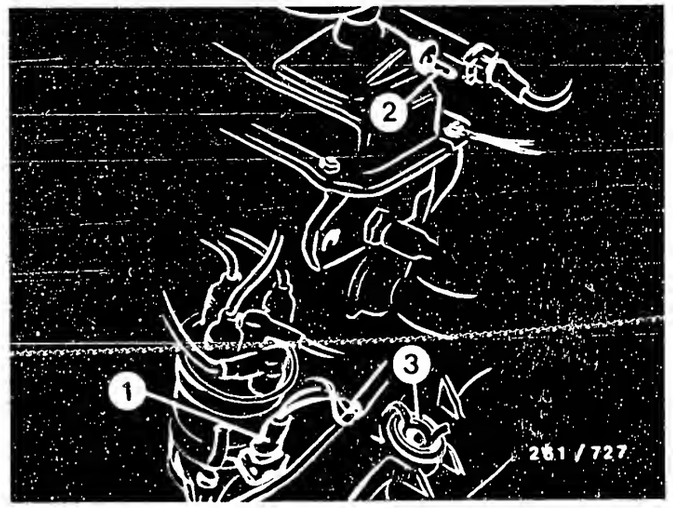




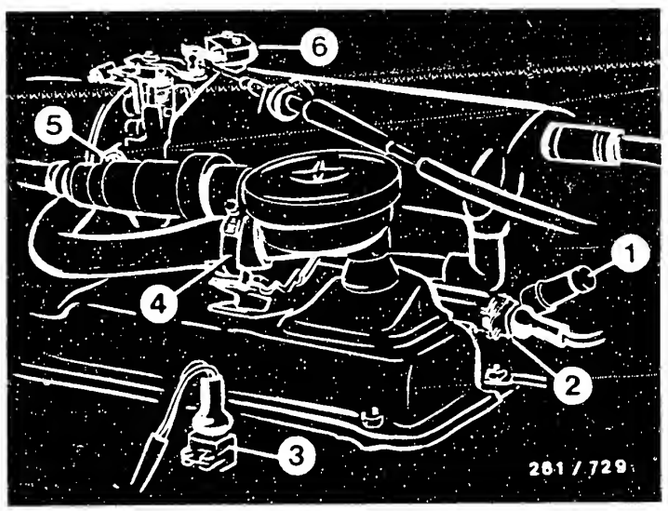


RAPID DIAGNOSIS CHART (Continued)

Test step	Testing of component/function Test instructions/conditions	Ctrl.-unit term-inals	Set values
24	Check spark-advance angle (basic setting). Engine at normal operating temperature, plug of temperature sensor (engine) disconnected. Engine speed 2000...2500 min $^{-1}$:	———	Basic setting value 4...8 °crankshaft
	Reconnect plug to temperature sensor (engine), engine speed approx.2300 min $^{-1}$. Subtract the basic-setting value from the spark-advance angle indicated and determine advance:		Advance 27...33 °crankshaft
	Note: If advance value is 10° crankshaft less than the set value, check the knock sensor (see "Test specifications") and determine spark-advance angle again. If necessary, replace knock sensor.		
25	Idle speed and CO. Connect motortester and CO analyzer (on vehicle with Cat, at CO measuring tube). Engine at normal operating temperature, loads switched off, disconnect hose of crankcase breather and seal off. Run engine for approx 1 min. at idle, then disconnect temperature sensor (engine), accelerate 3 times and measure idle speed / CO. Note: When the temperature sensor is connected, the values must remain within the tolerance.	———	750...850 min $^{-1}$ (valid for all versions) without lambda closed-loop control 0,5...1,5 % CO with lambda closed-loop control 0,3...1,1 % CO (sensor lead disconnected)
26	Low-idle-speed control Measure idle-actuator current. Idle speed, engine at normal operating temperature, loads switched off. Temperature sensor (engine) disconnected: Temperature sensor (engine) connected: Switch on loads (e.g. headlights, air conditioner, etc.):	———	approx. 430 mA approx. 430 mA fluctuating depending upon load 430...1000 mA



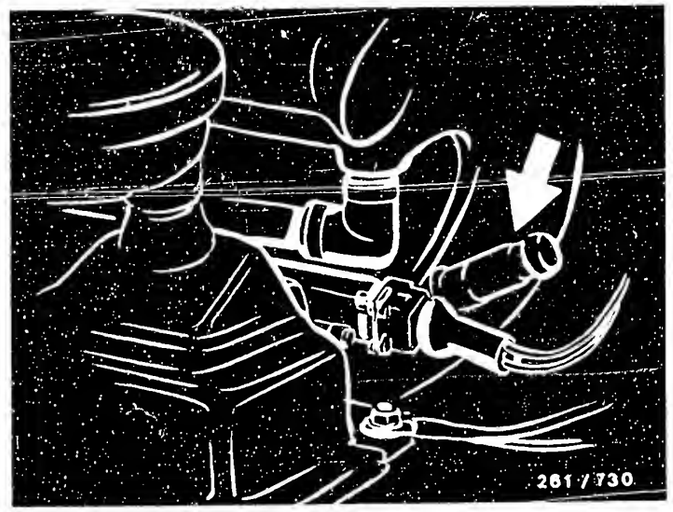
1= Plug on magnetic pulse generato
2= Pressure-gauge connecting point fuel-distribution pipe
3= Ignition point or TDC marking (remove cap)



1= CO measuring tube on Cat
2= Common injection-valve plug
3= Temperature sensor (engine)
4= Crankcase breather
5= Idle-speed adjusting screw
6= Full-load switch

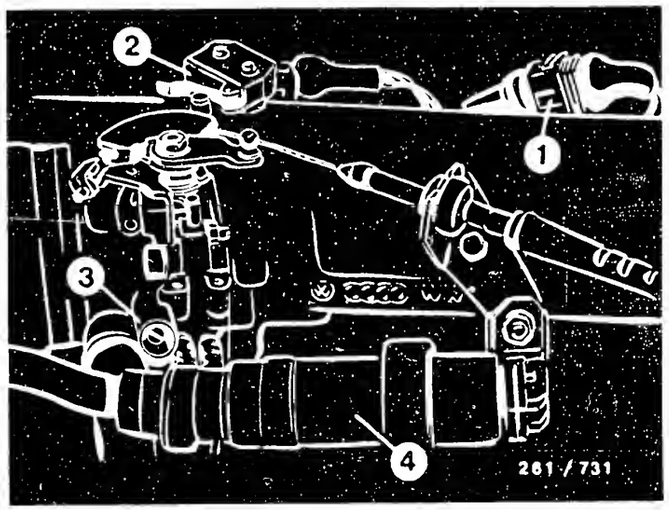
RAPID DIAGNOSIS CHART (Continued)

Test step	Testing of component/function Test instructions/conditions	Ctrl.-unit term-inals	Set values
26	Upper limit of lambda closed-loop control. CO analyzer upstream of the catalytic converter (to CO measuring tube). Idle speed; engine and catalytic converter at normal operating temperature; pull apart plug-in connection to lambda sensor and apply connection on control-unit side (black lead) to ground.	———	CO rises above 1,1 % by vol. (Conduct test step rapidly)
27	As Test step 26, however, test lower limit of lambda closed-loop control. Apply lambda input to approx. +2V, e.g. to positive terminal of a 1.5 V monocell (connect negative terminal to vehicle ground).	———	CO drops below 0,3 % by vol. (rough idling)
28	Control limit and lambda sensor in closed-loop-control mode: Plug-in connection to lambda sensor connected up; run engine (at normal operating temp-erature) at idle; note down CO values: Disconnect air hose from fuel-pressure regulator and seal off:	———	CO= 0,3...1,1 % by vol. CO rises briefly and drops back to control value above



Arrow = CO measuring tube on Cat

1 = Lambda-sensor plug-in connection
2 = Full-load switch
3 = Idle-speed adjusting screw (Basic setting)
4 = Idle actuator



Idle speed: 800 ± 50 min $^{-1}$

Exhaust-gas adjustment
* CO value at idle with engine at normal operating temp.:
  version without catalytic converter 1,0 ± 0,5 %
  with catalytic converter without lambda sensor (1) 1,0 ± 0,5 %
  with catalytic converter and lambda sensor (1)(2) 0,7 ± 0,4 %

(1) = Measured at CO measuring tube
(2) = Lambda-sensor plug-in connection pulled apart

Pressure regulator
* Fuel pressure: 3,0 ± 0,2 bar

Electric fuel pumps
Fuel delivery (measured in return line)
* Fuel pump: at least 500 cm ^{3} /30s
* Pre-supply pump: at least 900 cm ^{3} /30s
* Supply voltage (under load): at least 12 V

Temperature sensor (engine)
Internal electrical resistance at
* ambient temperature (+15°C...+30°C): 1,45...3,3 k Ω
* with engine at normal operating temperature (approx. +80°C): 280...360 Ω

Solenoid-operated injection valve:
Internal electrical resistance at
* ambient temperature (+15°C...+30°C): 15...17,5 Ω

Idle actuator
* Internal electrical resistance: approx. 4 Ω

Knock sensor
* Internal electrical resistance: greater than 1 M Ω
* Tightening torque: 15...25 Nm
(when checking, first loosen screw)

Air-flow sensor

* Internal electrical resistance
  between term.2 and term.4: 8...2500 Ω (1)
  term.3 and term.4: 500...1100 Ω

(1) = (Deflect air-flow sensor flap as far as it will go).

Temperature sensor (intake air)

* Internal electrical resistance measured at air-flow sensor between term.1 and term.4 at ambient temperature (+15°C...+30°C): 1,45...3,3 k Ω

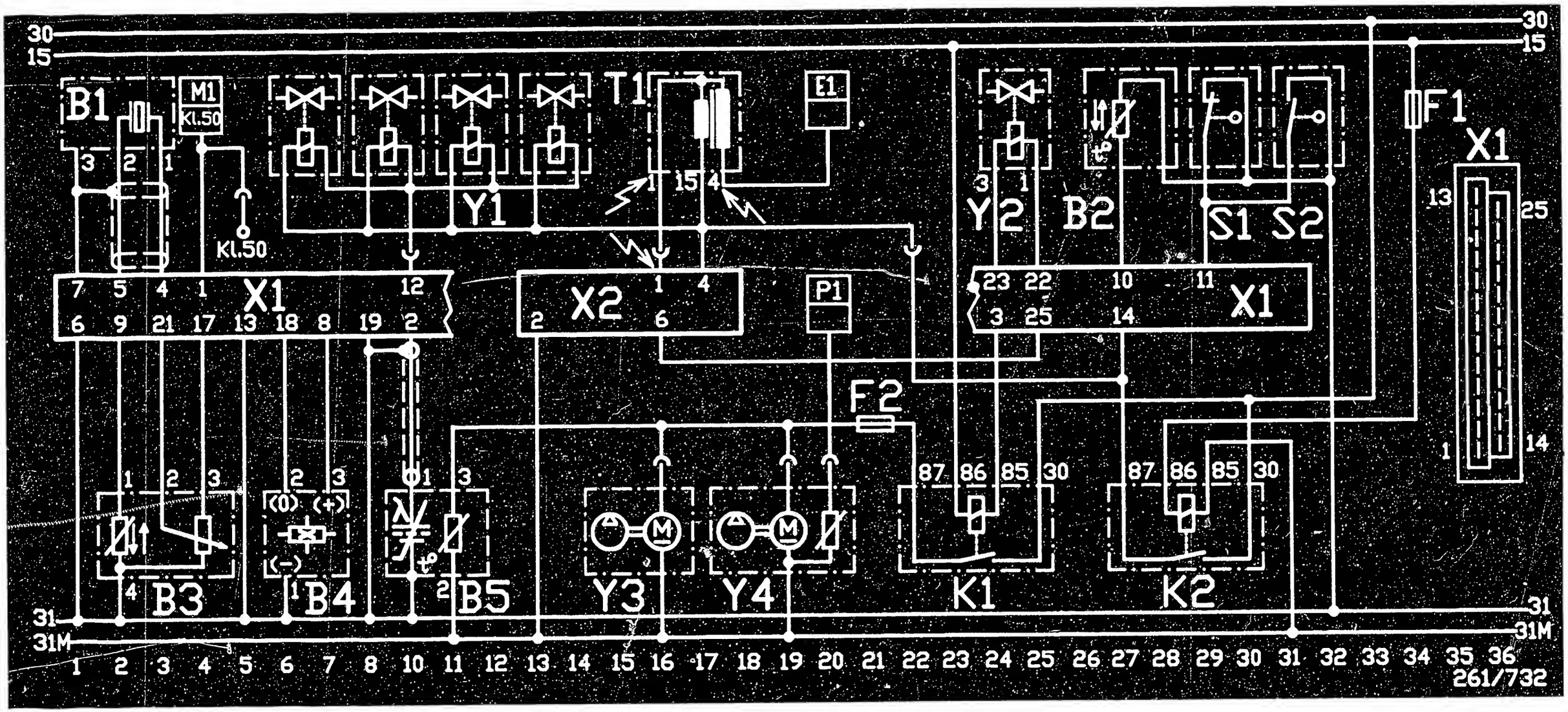
Ignition coil

* Primary resistance (term.1/term.15): 0,5...0,8 Ω
* Secondary resistance (term.1/term.4) : 2,4...3,5 k Ω

Lambda-sensor heater winding: 1...15 Ω

Interference-suppression resistors

* Ignition-distributor rotor: 0,6...1,4 k Ω
* Distributor cap : 0,6...1,4 k Ω
* Spark-plug connector : 4,0...6,0 k Ω



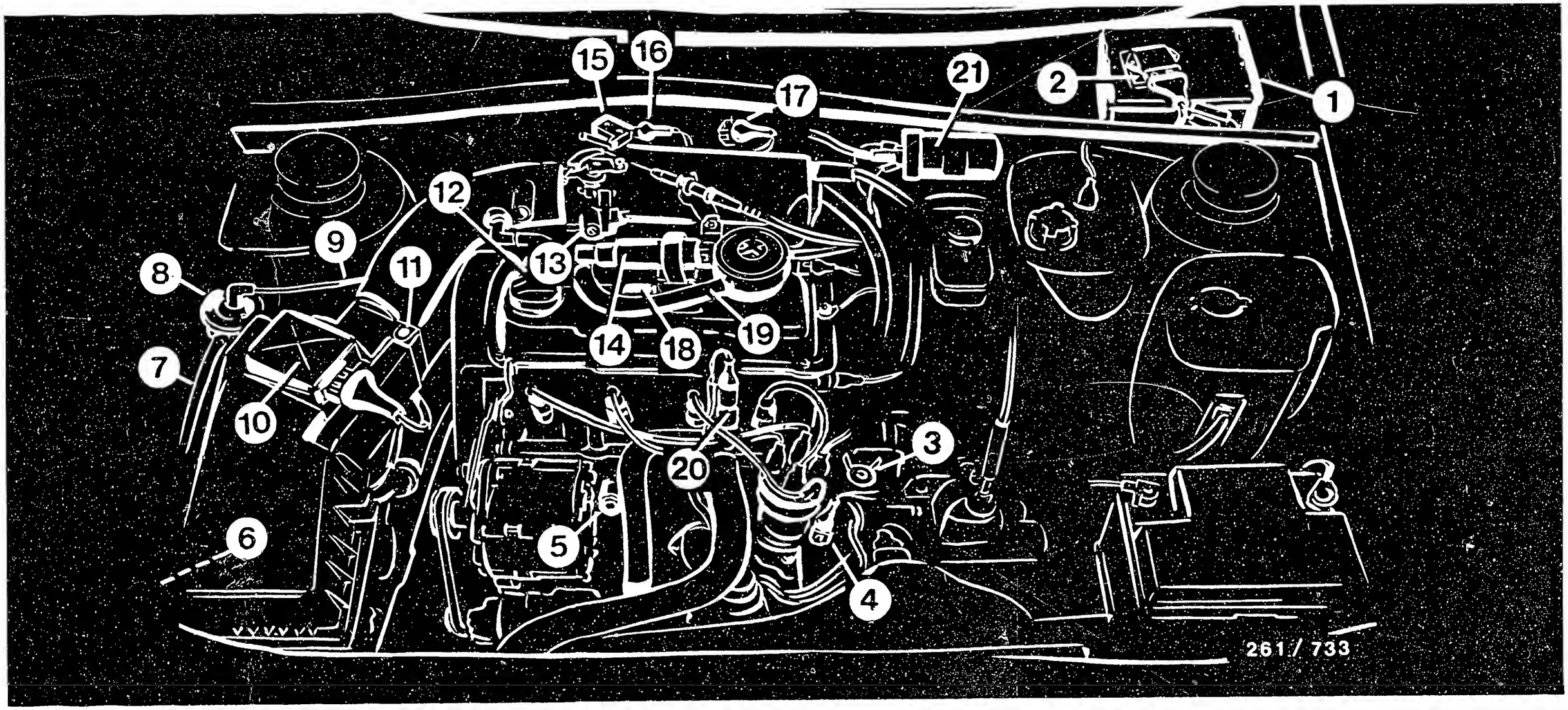
B1= Knock sensor
B2= Temperature sensor (engine)
B3= Air-flow sensor
B4= Magnetic pulse gen. (Hall generator)
B5= Heated lambda sensor (Cat)
E1= High-voltage distributor
F1= Main relay fuse
F2= Pump fuse

K1= Pump relay
K2= Main relay
M1= Starting motor
P1= Fuel gauge
S1= Idle switch
S2= Full-load switch
T1= Ignition coil
X1= Digifant control-unit plug

X2= Ignition-trigger-box plug
Y1= Solenoid-operated injection valves
Y2= Idle actuator
Y3= Electric fuel pump
Y4= Pre-supply pump with sensor (in tank) for fuel gauge

ELECTRICAL TERMINAL DIAGRAM - DIGIFANT

E19 ⟹
E20 ⟸



1= Digifant control unit
2= Ignition trigger box
3= TDC marking
4= Plug to magnetic pulse generator
5= Knock sensor
6= Activated-carbon canister of tank ventilation
7= Suction hose to activated-carbon canister (Cat)
8= Shutoff valve of tank ventilation
9= Activation lead
10= Air-flow sensor
11= CO adjusting screw
12= Pressure regulator (installation position only outlined in illus.)
13= Idle-speed adjusting screw
14= Idle actuator
15= Full-load switch
16= Plug to full-load/idle switch
17= Lambda-sensor plug-in connection
18= Injection valves
19= Hose for crankcase breather
20= Temperature sensor (engine)
21= Ignition coil

INSTALLATION POSITION OF COMPONENTS

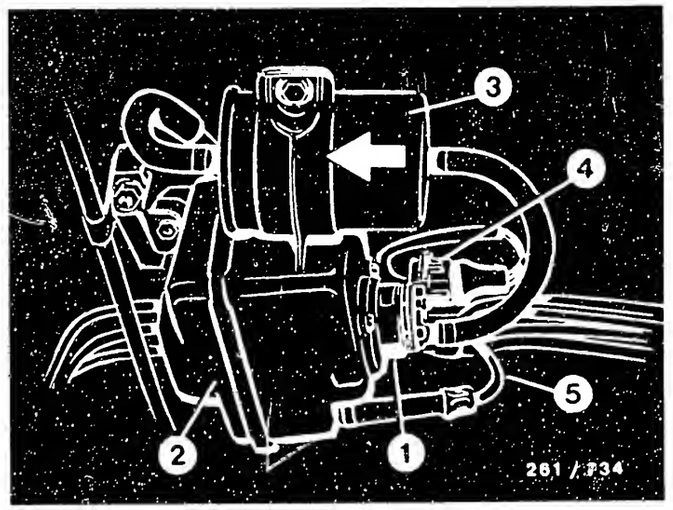
The indications "right" and "left" always refer to the forward direction of travel.

Main and pump relays and pump fuse:
In the fuse box underneath the instrument panel on the left-hand side.
Main relay in relay position No.1.
Pump relay in relay position No.2.
Pump fuse No.5 (fifth from left).

Fuel pump and fuel filter:
Beneath the vehicle near to the fuel tank.
See upper illustration.

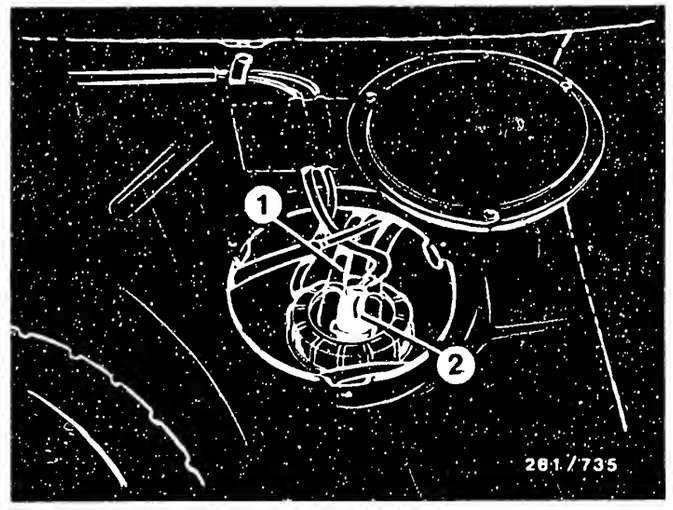
Pre-supply pump::
In the fuel tank (lower illustration).

Air-intake temperature sensor:
Integrated in the air-flow sensor.



1= Electric fuel pump
2= Pump accumulator
3= Fuel filter
4= Connector
5= From the pre-supply pump
Arrow= Direction of flow

Installation position of the pre-supply pump
1=Supply line (measuring point for fuel delivery of pre-supply pump)
2=Connector for pre-supply pump and fuel gauge

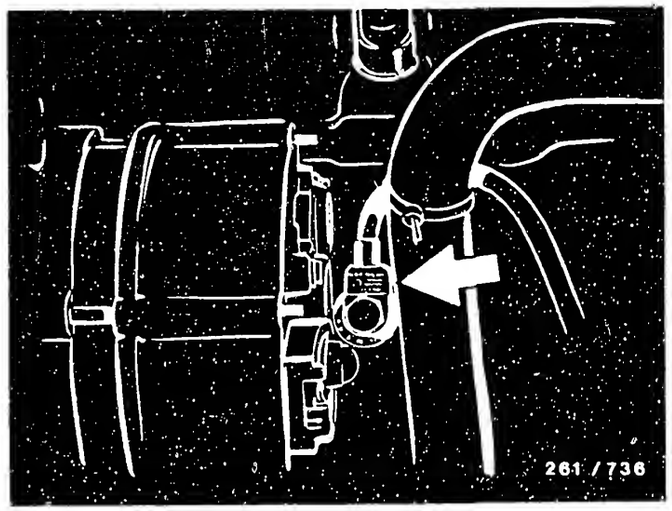


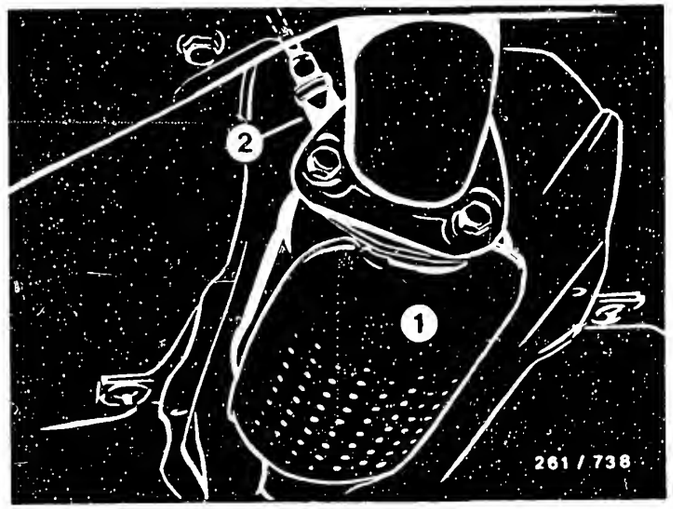
INSTALLATION POSITION OF COMPONENTS (Continued)

Knock sensor:
On the engine block at the front (upper illustration, arrow).

Plug-in connection to knock sensor:
Near to the ignition distributor (center illustration, arrow).

Lambda sensor:
In the catalytic converter.
See lower illustration ...Pos.1 = Catalytic converter.
Pos.2 = Lambda sensor.





Trouble-shooting instructions : CIT-5004

BOSCH system : LU 2-Jetronic

Make of vehicle : CITROEN

Basic microcard : OPE-512

TABLE OF CONTENTS

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Safety and precautionary measures	03
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SPEACIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle models with 2.498 1/4-cyl. engine:

Citroen CX 25 GTI	07.86->
Citroen CX 25 RI	07.86->
Citroen CX 25 Prestige Automatic	07.86->

* LU2-Jetronic with 25-pin control unit 0 280 000 353

* Engine-speed triggering from term. TD of the ignition control unit

* 5-pin air-flow sensor

* 7-pin control relay

* Start control, i.e. additional injected fuel quantity via all solenoid-operated injection valves.

* Lambda sensor for lambda closed-loop control and catalytic converter

* For testing the fuel pressure, use pressure gauge and hose lines of the pressure tester.

* Connect connecting part KDJE-P 100/14 into the fuel-inlet line.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Prevent fuel from being injected during the compression test.
  For this reason, disconnect control relay.

For further precautionary measures, see basic instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, fuel injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*		*		Universal test adapter
*											Electric fuel pump
*	*	*	*								Auxiliary-air device/idle actuator
*	*	*	*	*	*	*	*				Air-flow sensor/air-mass sensor
*	*	*	*		*						Intake system
		*	*	*		*	*				Solenoid-operated injection valves
*	*	*			*	*					Fuel pressure
				*	*						Fuel quantity
		*	*	*	*	*					Throttle valve
				*							Overrun cut-off
*		*									Start control
				*							Ground
*	*	*	*	*	*						Alternator, interference suppress.
		*	*	*		*					CO exhaust-gas adjustment
				*							Control unit
						*					Catalytic converter
		*	*	*	*						Lambda closed-loop control

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 123

Test step	Switch V	Switch Ω	Termi-nals	Testing of component/function	Test instructions/ Test conditions	Set values
1	5	–	1 – 5	TD pulses from ignition control unit	Shift into neutral, start engine	TD pulses on oscilloscope
2	6	–	9 – 5 (+) (–)	Voltage from control relay term. 87	Shift into neutral, start engine	8...15 V
3	7	–	4 – 5 (+) (–)	Voltage from ignition and starting switch term. 15	Shift into neutral, start engine	8...15 V
4	| V	11	8 – 5	Resistor set in air-flow sensor	——	100...200 Ω
5	| V	12	7 – 5	Resistance of potentio-meter in air-flow sensor	Deflect air-flow sensor flap as far as it will go	60...1000 Ω
6	| V	13	10 – 5	Resistance, temperature sensor (engine)	+15...+30°C: Approx. +80°C:	1,45...3,3 k Ω 280...360 Ω
7	| V	14	13 – 5	Frame connection of output stage		0...10 Ω

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 123

Test step	Switch V	Switch Ω	Termi-nals	Testing of component/function	Test instructions/ Test conditions	Set values
8	| V	15	25 - 5	Frame connection of output stage		0...10 Ω
9	| V	16	2 - 9	Resistance of idle contact	Accelerator pedal in rest position : Depress accelerator pedal slightly :	0...10 Ω Infinity Ω
10	| V	17	3 - 9	Resistance of full-load contact	Accelerator pedal in rest position : Depress accelerator pedal to floor :	Infinity Ω 0...10 Ω
11	| V	18	12 - 9	Resistance of the shunt-connected solenoid-operated injection valves	+15...+30°C : Approx. +80°C :	7,00... 9,50 Ω 7,20...10,00 Ω

REMARK: The following components with their respective connection leads are not covered by the universal test adapter when testing:

1. Auxiliary-air device: positive lead from term. 87 of control unit, negative lead to engine ground.
2. Electric fuel pump: positive lead from term. 87b of control relay (via pump fuse), negative lead to vehicle ground.
3. Sensor heater: positive lead from term. 87b of control relay (via sensor fuse), negative lead to engine ground.
4. Lambda sensor: sensor lead to control unit term. 20 (shielding at term. 5), sensor housing to vehicle ground.

TEST SPECIFICATIONS

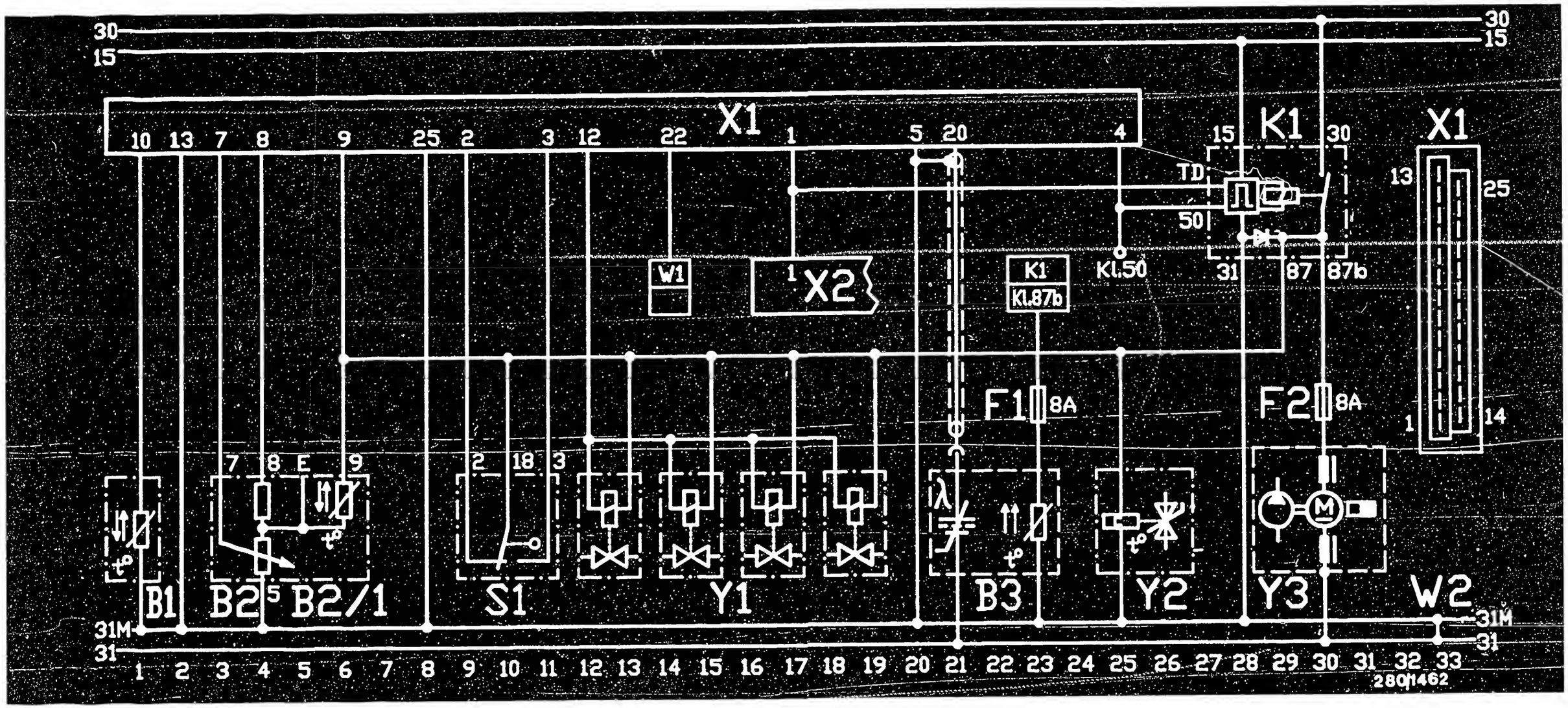
Component/function	Set values
Electric fuel pump	
* Fuel delivery and return:	at least 750 cm ^{3} /30 s
* Supply voltage under load:	at least 12 V
Pressure regulator	
* Fuel pressure with engine at standstill:	2,3...2,7 bar
at idle:	approx. 0.5 bar lower
Fuel system, leakages	
* Fuel pressure after 20 mins. with engine at standstill:	at least 1.0 bar
Auxiliary-air device	
* Resistance value	40...75 Ω
Air-flow sensor	
* Resistance value between	
term. 8 and term. 5:	340 ... 450 Ω
term. 7 and term. 5:	60 ...1000 Ω 1)
term. 9 and term. 5:	500 ... 760 Ω
term. 8 and term. 9:	160 ... 300 Ω
Temperature sensor (engine)	
* Internal electrical resistance at ambient temperature +15...+30°C:	1,45...3,3 k Ω
With engine at warm. op. temp. approx. +80°C :	280...3,3 Ω
Lambda-sensor heater	
* Internal electrical resistance (PTC) with engine at standstill:	1...15 Ω

1) (Fully deflect air-flow sensor flap)

TEST SPECIFICATIONS (Continued)

Component/Function	Set values
Solenoid-operated injection valve	
* Internal electrical resistance at ambient temperature +15...+30°C:	15,0...17,5 Ω
* Leakage after 60s:	no drop must fall
Start control	
* Voltage at injection valve on initiation of starting:	greater than 1.5 V
after approx. 15s:	approx. 0.5 V
Idle adjustment	
Engine at normal op. temp., approx. +80°C	
* Idle speed:	850...950 min $^{-1}$
CO adjustment	Integrator voltage
Engine at norm. op. temp., approx. +80°C	(test pin term. 22)
* Open-loop control (pull apart plug-in connection of sensor lead):	fixed voltage value between 5 ... 9 V
* Closed-loop control (connect up plug-in connection):	indicator fluctuates between 2 voltage values
* Adjustment:	mean value with closed-loop control same as with open-loop control
* Rich value (pull apart plug-in connection and apply control-unit lead to ground):	10...13 V
* Lean value (apply 2V to control-unit lead):	less than approx. 1.0 V

See equipment and Autodata microcards for the setting values for ignition, valve clearance and other engine-related data.



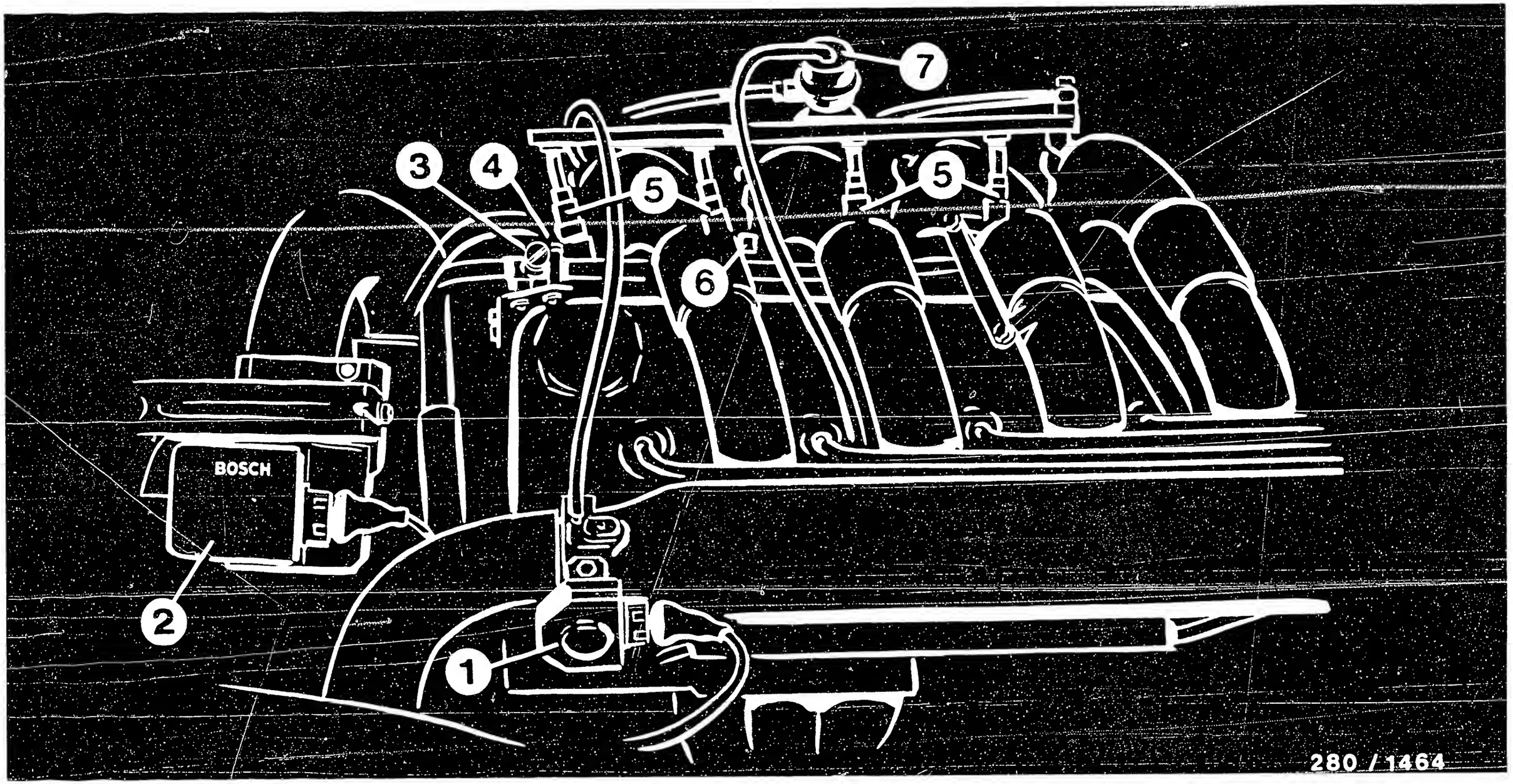
B1 = Temperature sensor (engine)
B2 = Air-flow sensor
B2/1= Temperature sensor (air intake)
B3 = Heated lambda sensor
F1 = Fuse (electric fuel pump)
F2 = Fuse (sensor heater)
K1 = Control relay

S2 = Throttle-valve switch
W1 = Test pin/integrator voltage
W2 = Ground strap, engine
X1 = Control-unit plug
X2 = Ignition control-unit plug
Y1 = Solenoid-operated injection valves
Y2 = Auxiliary-air device
Y3 = Electric fuel pump

ELECTRICAL TERMINAL DIAGRAM

F11 ⟹

F12 ⟸

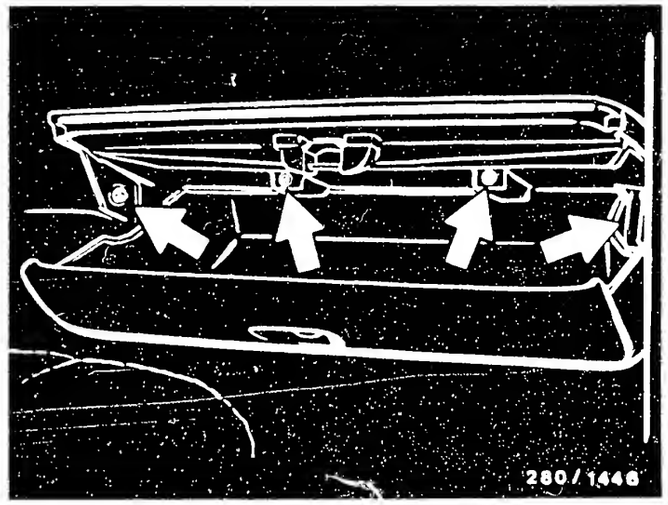


1 = Throttle-valve switch
2 = Air-flow sensor
3 = Idle adjusting screw
4 = To temperature sensor (engine)
5 = Solenoid-operated injection valves
6 = To auxiliary-air device
7 = Pressure regulator

INSTALLATION POSITION OF COMPONENTS

* LU2-Jetronic control unit is located behind the glove compartment.

Notes on removal: Loosen fastening screws (see upper illustration, arrows).
Pull the glove compartment out forwards.
Pull away the floor mat.
Loosen the fastening nuts (see lower illustration, arrows) from the floor pan.

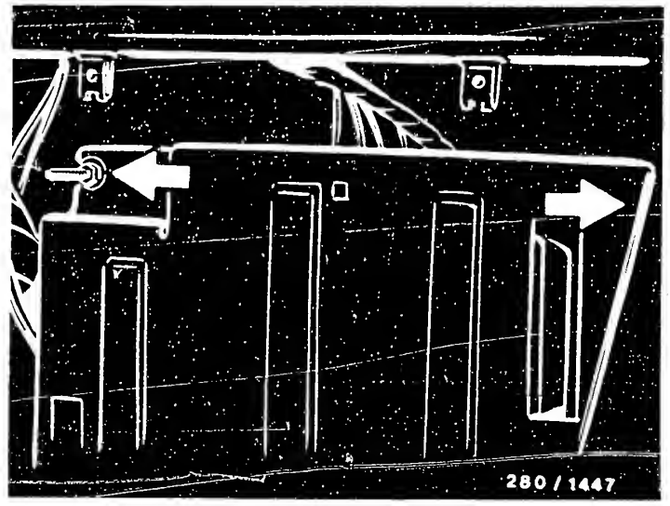


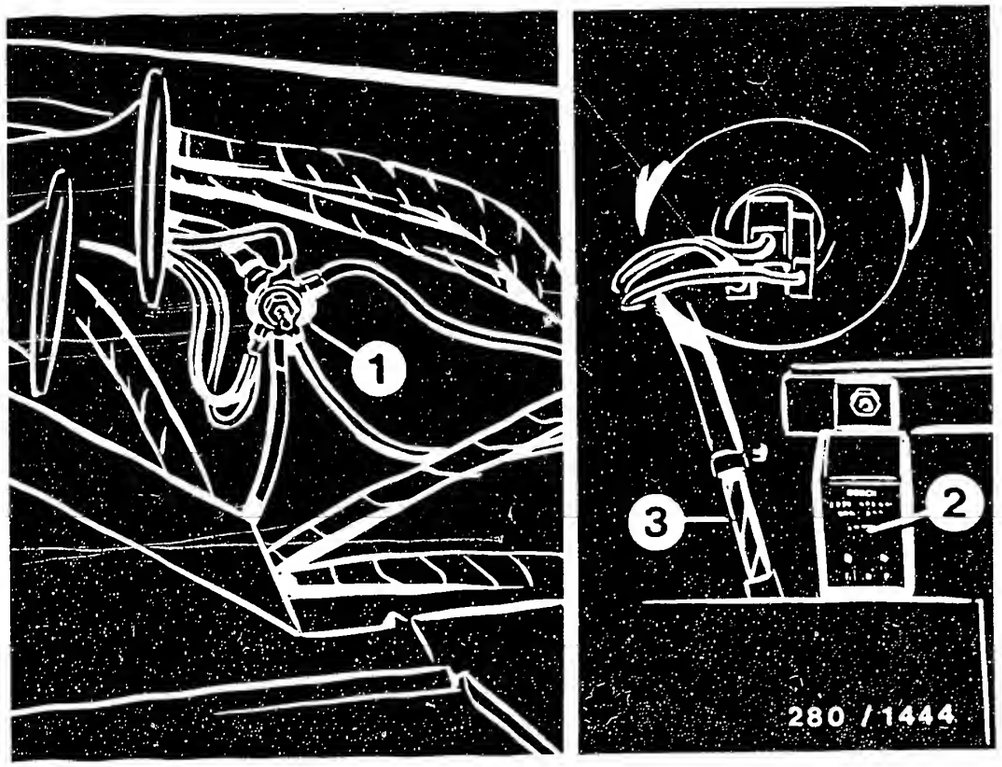
Further components not illustrated

* Test pin (integrator voltage) is located near the battery. It is a 2-pin plug (color, light brown).
  Light brown lead = Ground (-)
  Green lead = Positive (+)

* Lambda-sensor plug is located near to the battery.

* Lambda sensor is located in the exhaust pipe upstream of the catalytic converter.
* Fuel pump is located in front of the rear axle (frame cross-member) on the right in a rubber mounting.

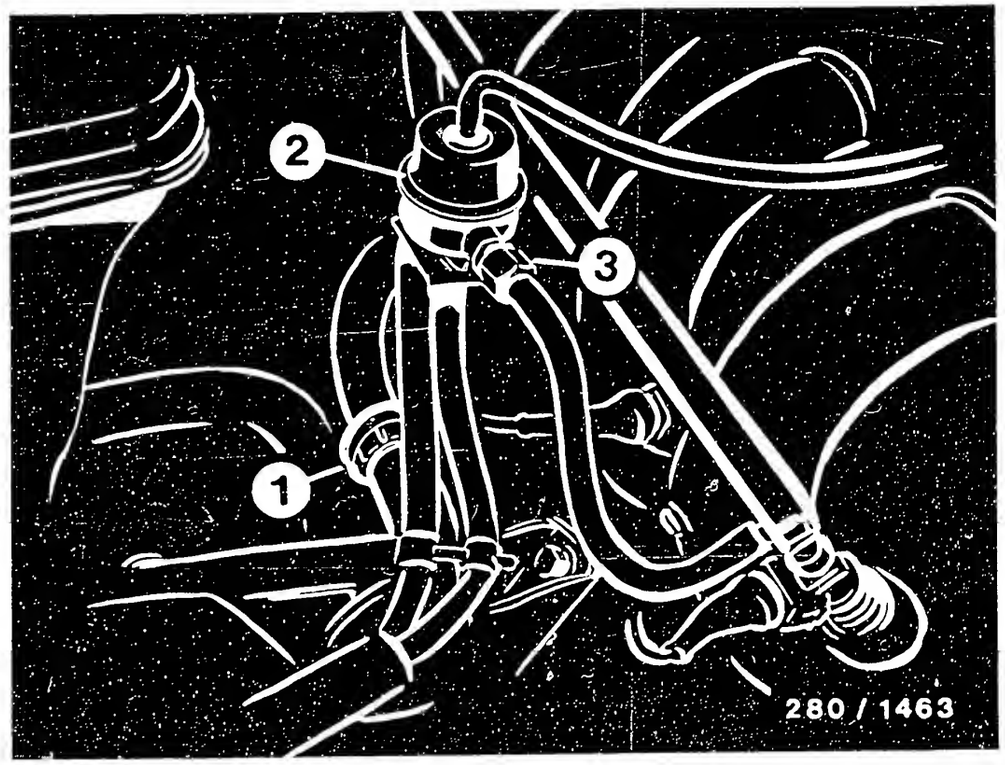




1 = Central ground
2 = Control relay

The indications "right" and "left" always refer to the forward direction of travel.

* Control relay (blue) is positioned near to the right-hand headlight. It is protected by a plastic sleeve.



1 = Auxiliary-air device
2 = Pressure regulator
3 = Pressure-test connection

FUEL PRESSURE TEST

For testing the fuel pressure, use pressure gauge and hose lead of the pressure tester KDJE-P 100.

Interconnect the connecting part KDJE-P 100/14 at the fuel-distribution-pipe inlet and connect the hose line to the pressure gauge at the side threaded connector.

Caution. When opening the fitting, make sure that no fuel comes into contact with hot engine components.

Trouble-shooting instructions : PEU-5007

BOSCH system : LH 2.2-Jetronic

Make of vehicle : PEUGEOT / VOLVO

Basic microcard : SAA - 504

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SPECIAL FEATURES

These brief instructions, valid at the time of publication, apply to the following vehicle models with 2.8 l / 6-cyl. engine:

PEUGEOT 505 2.8 Injection V6 ZN3J engine 2.850 l			06.86->
CH, EU, S	without lambda	ECU 0 280 001 507	
USA	with lambda	ECU 0 280 001 506	
VOLVO 760, 780 2.8 Injection B 280 E, E-NO, and F engines 2.848 l			05.86->
B 280 FS engine			05.88->
EU excl. CH, S	without lambda	ECU 0 280 001 505	
CH, S, North	without lambda	ECU 0 280 001 508	
CAL, J, USA	with lambda	ECU 0 280 001 510	
EU, USA	with lambda	ECU 0 280 001 512	
FIAT Thema 6V 2.848 l engine			05.88->
EU	with lambda	ECU 0 280 001 511	

* LH2.2-Jetronic with 25-pin control unit.
* Engine-speed triggering at control unit term. 1 by TN signals from term. 17 of the ignition control unit.

* Double temperature sensor (engine) for Jetronic and ignition.
* Low-idle-speed control with two-winding rotary actuator.
* Start control, i.e. additional injected fuel quantity via all solenoid-operated injection valves..
* CAL, (EU), J and USA models with lambda closed-loop control and heated sensor.
* B 280 E North engine with exhaust-gas recirculation and secondary-air induction (Pulsair).
* Volvo vehicles with auxiliary relay for injection valves and rotary actuator for the purpose of radio-interference suppression.

* For testing the fuel pressure, connect pressure tester with three-way line KDJE-P 100/13 to the fuel-inlet distribution pipe.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

* Avoid injection of fuel when testing the compression.
  To ensure this, disconnect pump relay.

For further precautionary measures, see brief instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptom of trouble)

1. Starting motor operates, but engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Rough idling (engine speed, exhaust gas).	4. Poor throttle response, flat spot during acceleration.	5. Engine misfiring (ignition, fuel injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*		*		Universal test adapter
*											Electric fuel pump
*	*	*	*								Auxiliary-air device/idle actuator
*	*	*	*	*	*	*	*				Air-flow sensor/air-mass sensor
*	*	*	*		*						Intake system
		*	*	*		*	*				Solenoid-operated injection valves
*	*	*			*	*					Fuel pressure
				*	*						Fuel quantity
		*	*	*	*	*					Throttle valve
				*							Overrun cut-off
*		*									Start control
				*							Ground
*	*	*	*	*	*						Alternator, interference suppress.
		*	*	*		*					CO exhaust-gas adjustment
				*							Control unit
						*					Catalytic converter
		*	*	*	*						Lambda closed-loop control

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

Test step	Switch V	Switch Ω	Terminals	Testing of component/function	Test instructions/ Test conditions		Set values
1	| V	5	2 – 11	Resistance, temperature sensor (engine)	Connect adapter lead only to periphery.	+15...+30°C: Approx. +80°C:	1.45...3.3 k Ω 280...360 Ω
2	| V	6	25 – 11	Frame connection of output stage			0...10 Ω
3	| V	7	5 – 11	Frame connection of sensors			0...10 Ω
4	| V	8	13 – 11	Resistance of the shunt-connected solenoid-operated injection valves, in Peugeot and Fiat over electric fuel pump and sensor heater, in Volvo over bridge at auxiliary-relay pin base	Volvo: disconnect auxiliary relay and bridge term. 1 with term. 3 in pin base.	+15...+30°C: Approx. +80°C:	6,6...9,0 Ω 6,9...9,5 Ω
5	| V	9	3 – 11	Resistance of idle contact	Disconnect plug from ignition control unit.	Accelerator pedal in rest position: Depress accelerator pedal slightly:	0...10 Ω Infinity Ω
6	| V	10	12 – 11	Resistance of full-load contact	Plug remains disconnected.	Accelerator pedal in rest position: Depress accelerator pedal to floor:	Infinity Ω ...10 Ω
7	| V	10	12 – 11	Resistance of low-idle-speed-control test pin	Apply test pin to ground		0...10 Ω
8	| V	11	10 – 11	Resistance of idle actuator, 1st winding	Connect plug on ignition control unit. Volvo: term. 1 and term. 3 in auxiliary-relay pin base remain bridged.	+15...+30°C: Approx. +80°C:	20...32 Ω 24...37 Ω

G05 — ⟹

G06 — ⟺

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)
Adapter lead: 1 684 463 141

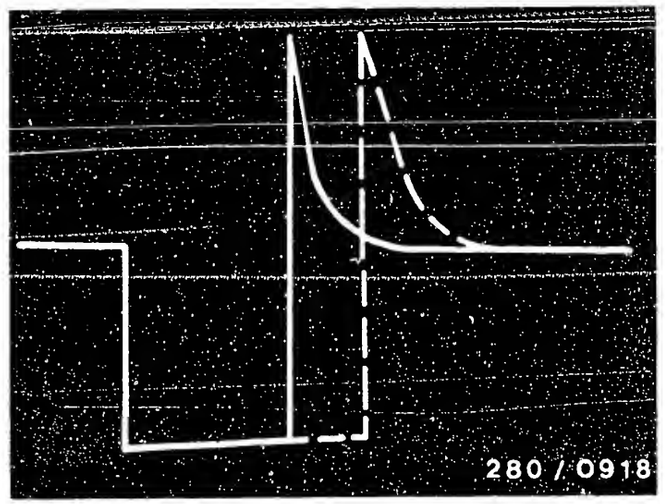
Test step	Switch V	Switch Ω	Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
9	| V	12	23 – 11	Resistance of idle actuator, 2nd winding	Adapter lead remains connected to periphery. +15...+30°C: Approx. +80°C: After test, remove bridge and reconnect auxiliary relay.	18...30 Ω 22...34 Ω
10	| V	13	15 – 11	Overrun-cutoff suppression	If fitted. To test, select 1st or 2nd gear.	0...10 Ω
11	| V	21	14 – 6	Resistance, idle-mixture potentiometer	Dependent upon the CO setting	10...1100 Ω
12	5	21	1 – 11	TN signal from ignition trigger box term. 17	Shift into neutral, start engine	Rectangular pulses on oscilloscope
13	6	21	9 – 11 (+) (–)	Voltage from main relay term. 87 or main/pump relay 87/1	Press push-button 4	8...15 V
14	7	21	18 – 11 (+) (–)	Voltage from ignition and starting switch	Ignition "ON"	8...15 V
15	8	21	21 – 11 (+) (–)	Voltage at main relay term. 85 or main/pump relay 86/1		8...15 V
16	9	21	17 – 11 (+) (–)	Voltage at pump relay term. 85 or main/pump relay 86/2	Press push-button 4	8...15 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)
Adapter lead: 1 684 463 141

Test step	Switch V	Switch Ω	Terminals	Testing of component/function	Test instructions/ Test conditions	Set values
17	10	21	16 – 11	Voltage from air-conditioner switch (only if air conditioner fitted)	Connect adapter lead to periphery and control unit. Leave engine running. Switch on air conditioner.	8...15 V
18	3	21	7 – 6	Output voltage, hot-wire air-mass sensor	Leave engine running. If the engine speed changes, the output voltage must also change.	2...5 V
19	11	21	22 – 11	Voltage at integrator output, lambda closed-loop control (open-loop-control value)	Leave engine running until at normal operating temperature.	10...13 V
20	11	22	22 – 11	Voltage at integrator output, lambda closed-loop control (rich value)	Leave engine running until at normal operating temperature.	10...13 V
21	11	23	22 – 11	Voltage at integrator output, lambda closed-loop control (lean value)	Leave engine running until at normal operating temperature.	Less than 0.5 V
22	11	24	22 – 11	Voltage at integrator output, lambda closed-loop control (closed-loop-control value)	Leave engine running until at normal operating temperature. Conduct measurement at approx. 2500 min $^{-1}$.	0...13 V fluctuating
23	11	24		Basic idle speed	Leave engine running until at normal operating temperature. Apply test pin (low-idle-speed control) to ground.	680...720 min $^{-1}$

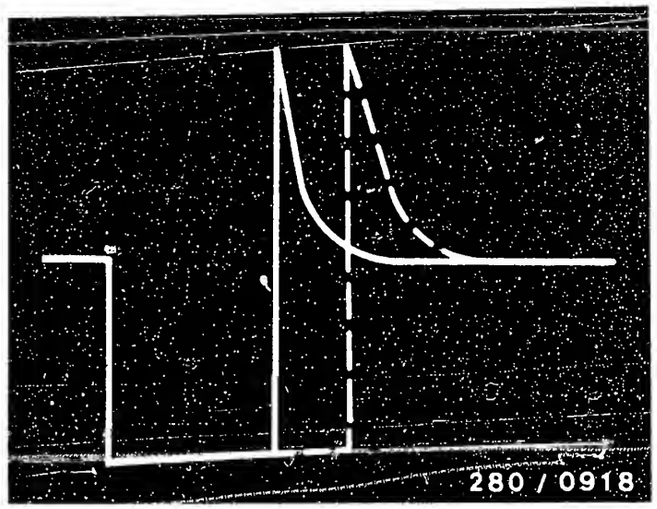
RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

Test step	Switch V	Switch Ω	Terminals	Testing of components/function Test instructions/conditions	Set values
24	11	24		On/off ratio at idle actuator Measurement with dwell-angle tester at sockets 1 and 2 Apply LFR* test pin to ground : Loosen LFR test pin from ground: In addition, switch on air conditioner (if fitted) : Accelerate; above 3000 min^{-1} , on/off ratio must increase : (*LFR = Idle mixture control.)	 29,9 % 31...33 % 34...37 % > 36 %
25	12	24	13 – 11	Injection signal t_i Leave engine running (at normal operating temperature)..	See upper illustration
26	12	24	13 – 11	Injection signal t_i Temperature sensor cold Leave engine running (at normal operating temperature). Press push-button 1. Duration of injection, engine speed and CO content become greater.	See upper illustration
27	12	24	13 – 11	Injection signal t_i Temperature sensor warm Leave engine running (at normal operating temperature). Press push-button 2. Duration of injection must remain constant.	See upper illustration



RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01
Adapter lead: 1 684 463 141

Test step	Switch V	Switch Ω	Terminals	Testing of component/function Test instructions/conditions	Set values
28	12	24	13 – 11	Injection signal t_i Full-load enrichment Leave engine running (at normal operating temperature). Press push-button 6. Duration of injection, engine speed and CO content become greater.	See upper illustration
29	13	24	8 – 11	Hot-wire air-mass flow sensor, self-cleaning operation Engine must run at speed exceeding 2000 min^{-1} and the engine temperature be greater than +60° C. Then, ignition "OFF" – voltage reading after approx. 4s.	2...5 V Reading duration approx. 1s.



TEST SPECIFICATIONS

Component/Function	Set values
Electric fuel pump	
* Fuel delivery at return:	at least 800 cm ^{3} /30 s
* Supply voltage under load:	at least 12 V
* Fuel delivery of pre-supply pump:	at least 900 cm ^{3} /30 s
Pressure regulator	
* Fuel pressure with engine at standstill:	2,3...2,7 bar
at idle:	approx. 0.5 bar lower
Fuel system, leaks	
* Fuel pressure after 20 mins with engine at standstill:	at least 1.0 bar
Idle actuator	
* Resistance value at +15...+30°C between	
term. 4 and term. 5:	17...22,5 Ω
term. 4 and term. 3:	19...25,0 Ω
Hot-wire air-mass sensor	
* Resistance value between	
term. 6 and term. 2:	0...1100 Ω
term. 3 and term. 2:	3.6...4.1 Ω
Temperature sensor (engine)	
Double version	
* Internal electrical resistance at ambient temperature	
+15...+30°C:	1.45...3.3 k Ω
with engine at normal op.temp. approx. +80°C :	280...360 Ω

TEST SPECIFICATIONS (Continued)

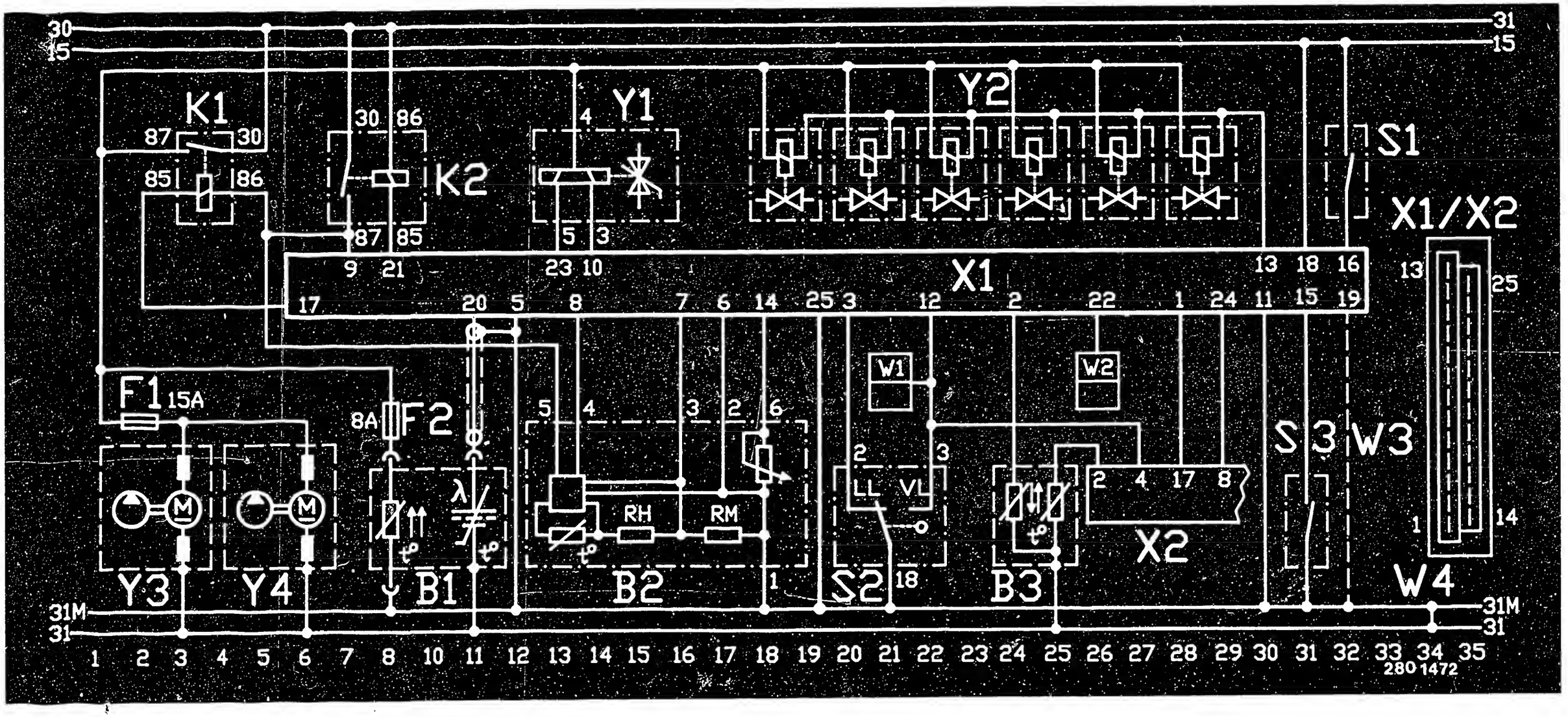
Component/Function	Set values
Solenoid-operated injection valve	
* Internal electrical resistance at ambient temperature +15...+30°C:	14.5...17.0 Ω
* Leakage after 60 s:	No drop must fall
Start control	
* Voltage at injection valve on initiation of starting:	Greater than 1.5 V
after approx. 15 s:	Approx. 0.5 V
Idle adjustment	
Eng. at norm. op. temp., approx.	+80°C
* Idle speed:	700...800 min $^{-1}$
at on/off ratio:	31...33 %
* Basic speed (test pin to ground):	680...720 min $^{-1}$
CO adjustment	
Eng. at norm. op. temp., approx.	+80°C
* Vehicles without lambda closed-loop control:	0,5...1,5 % CO by vol.
Vehicles with lambda closed-loop control	Integrator voltage (test pin term. 22)
* Open-loop control (pull apart plug-in connection of sensor lead):	Fixed voltage between 10...13 V
* Closed-loop control (connect up plug-in connection):	Indicator oscillating between 0...13 V
* Adjustment:	Regularly oscillating indicator between 0...13V
* Rich value (pull apart plug-in connection and apply control-unit lead to ground):	10...13 V
* Lean value (apply 2 V to controlunit lead):	Less than approx. 1.0 V

TEST SPECIFICATIONS (Continued)

Component/Function	Set values
Lambda sensor heater	
* Internal electrical resistance (PTC) with engine at standstill:	1...15 Ω

See equipment and Autodata microcards for the settings for ignition, valve clearance and other engine-related data.

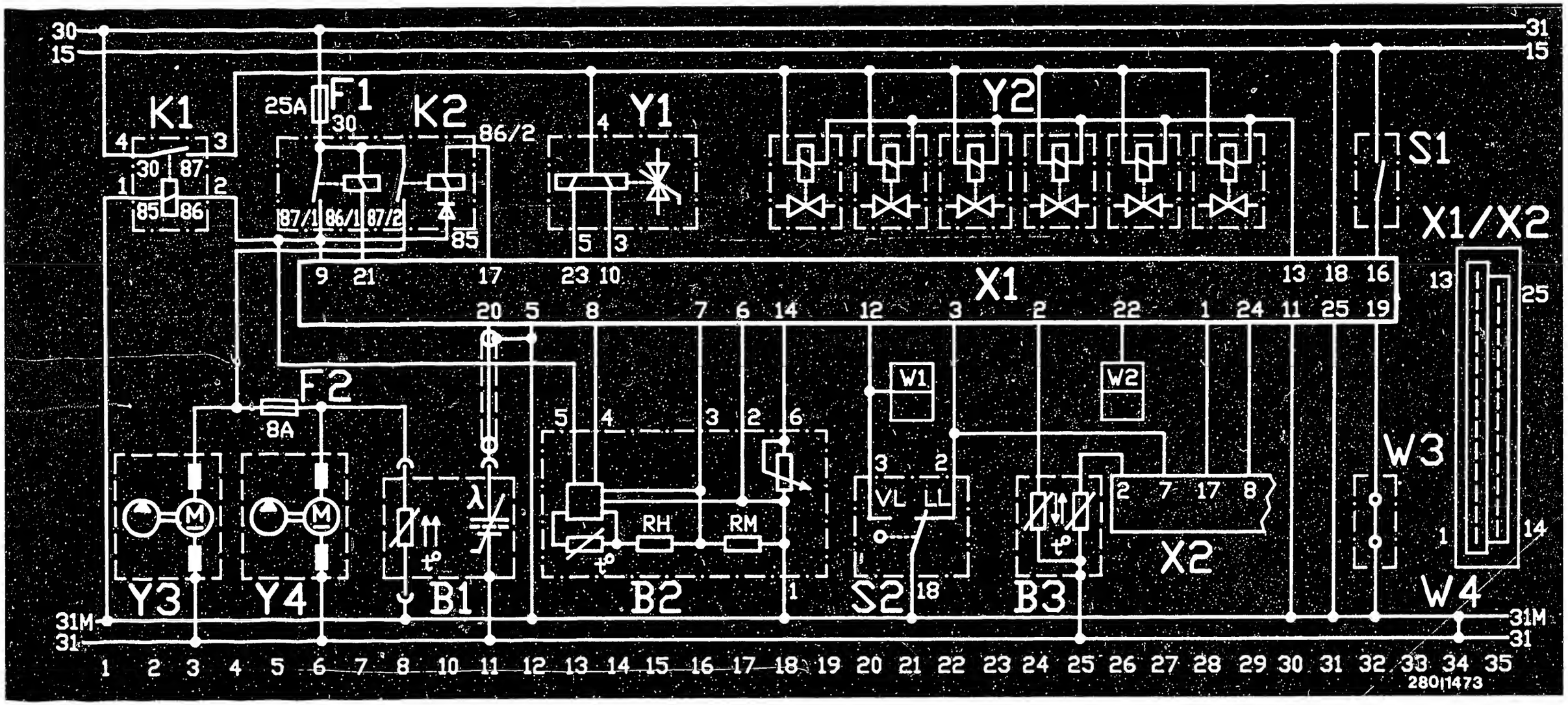
For production reasons: continued on the following coordinate.



B1 = Heated lambda sensor
B2 = Hot-wire air-mass sensor
B3 = Double temperature sensor (engine)
F1 = Pump fuse
F2 = Fuse, sensor heater
K1 = Pump relay
K2 = Main relay
S1 = Air-conditioner switch
S2 = Throttle-valve switch
S3 = Overrun-cutoff suppression (Fiat only)
W1 = Test pin, low-idle-speed control
W2 = Test pin, integrator voltage
W3 = TV encoder (lambda)
W4 = Ground strap, engine
X1 = Control-unit plug, Jetronic
X2 = Control-unit plug, ignition
Y1 = Idle actuator
Y2 = Solenoid-operated injection valves
Y3 = Electric fuel pump
Y4 = Pre-supply pump (Peugeot only)

ELECTRICAL TERMINAL DIAGRAM Peugeot and Fiat models

G19 — ⟹
G20 — ⟺



B1 = Heated lambda sensor
B2 = Hot-wire air-mass sensor
B3 = Double temperature sensor (engine)
F1 = Main/pump fuse
F2 = Fuse, sensor heater
K1 = Aux. relay (interference-suppression)
K2 = Main/pump relay
S1 = Air-conditioner switch
S2 = Throttle-valve switch
W1 = Test pin, low-idle-speed control
W2 = Test pin, integrator voltage (lambda)
W3 = TV encoder (lambda)
W4 = Ground strap, engine
X1 = Control-unit plug, Jetronic
X2 = Control-unit plug, ignition
Y1 = Idle actuator
Y2 = Solenoid-operated injection valves
Y3 = Electric fuel pump
Y4 = In-tank pre-supply pump

ELECTRICAL TERMINAL DIAGRAM Volvo models

INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.

All illustrations show the components in Peugeot models; the installation positions in Volvo models are similar.

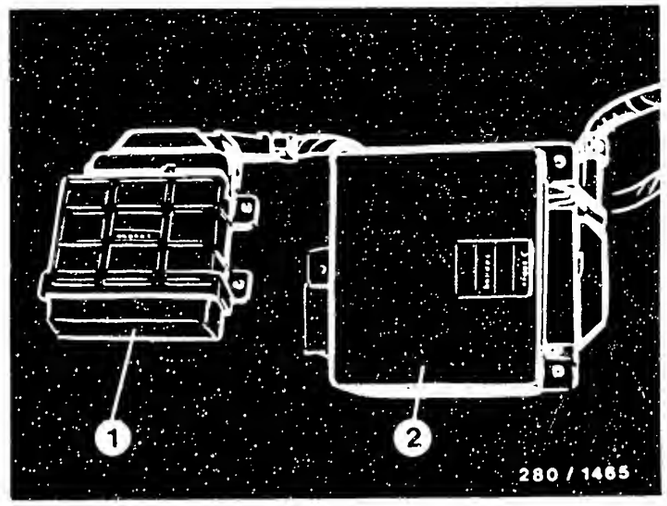
* Upper illustration
  Ignition control unit (1) and LH control unit (2) are located in the passenger compartment on the passenger side behind the glove compartment.
  To connect the universal test adapter, remove the control unit and disconnect the control-unit plug. To do this, unclip the locking tongue.

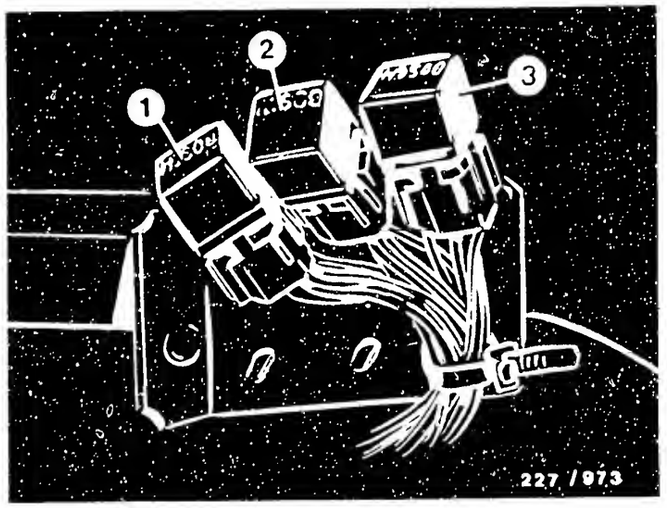
* Center illustration
  1 = Supply relay, ignition
  2 = Main relay
  3 = Pump relay

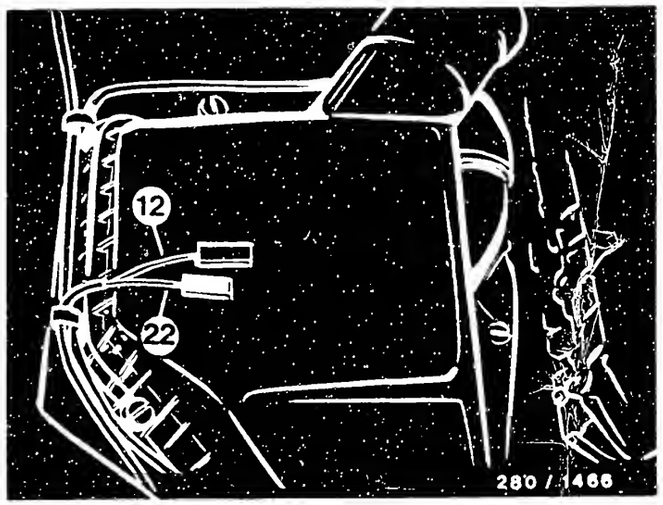
  Main and pump relays are combined in Volvo models. The main/ pump relay in Volvos is in the central electrics.

  An additional auxiliary relay (interference suppression) is located on the right-hand McPherson-strut dome in the engine compartment.

* Lower illustration
  Test pins next to the air filter.
  12, green lead = Test pin, low-idle-speed control.
  22, white lead = Test pin, integrator voltage (lambda).







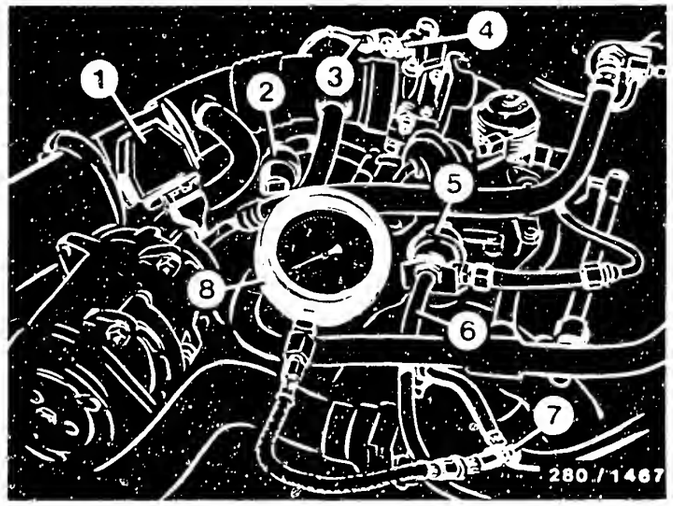
Components on engine

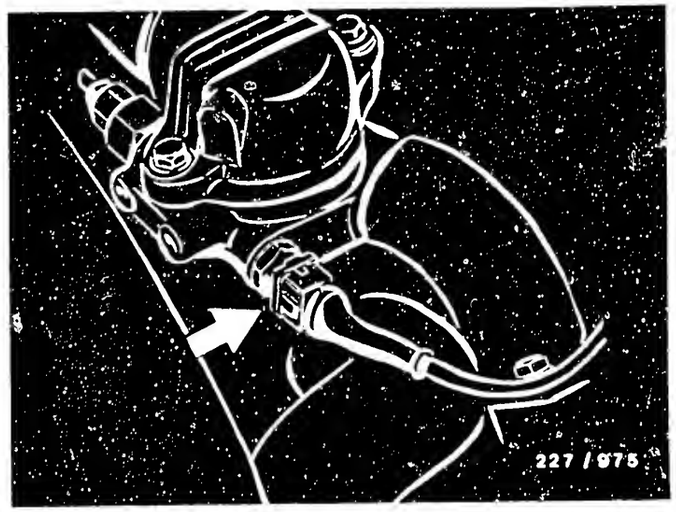
* Upper illustration
  Pressure tester KDJE-P100 with three-way line KDJE-P100/13 connected at fuel-inlet distribution pipe.

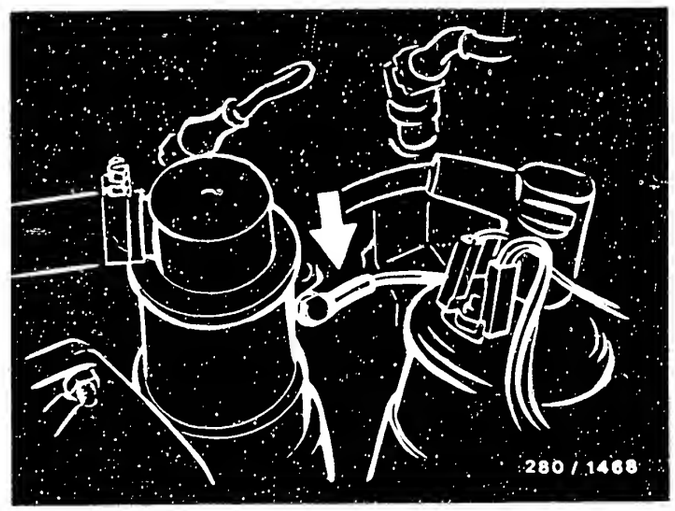
  1 = Hot-wire air-mass sensor
  2 = Idle actuator
  3 = Throttle-valve switch
  4 = Idle-speed adjusting screw (on/off ratio)
  5 = Pressure regulator
  6 = Fuel return line
  7 = Three-way line
  8 = Pressure tester

* Center illustration
  Double temperature sensor, engine (arrow) at coolant distributor.

* Lower illustration
  Central ground (arrow) on left-hand side of engine block.







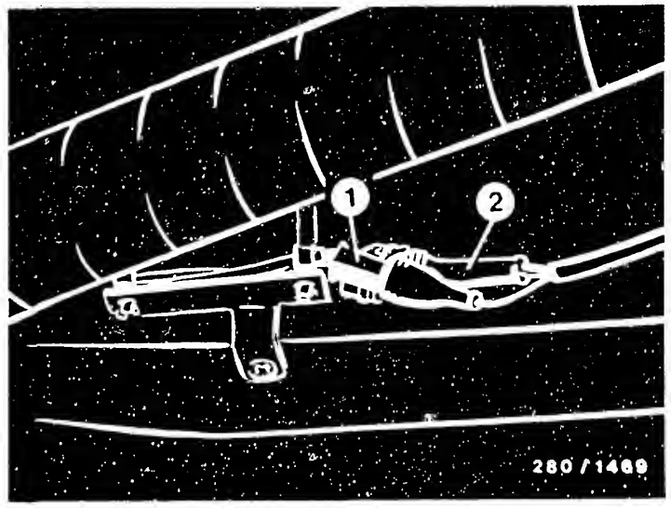
INSTALLATION POSITION OF COMPONENTS (CONTINUED)

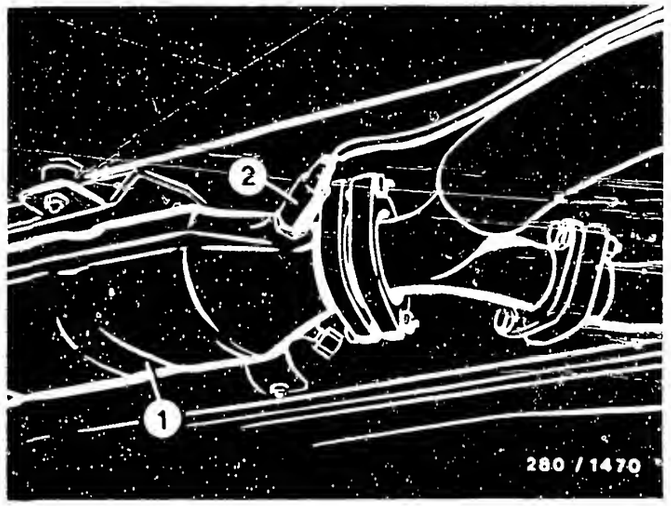
Components on vehicle floor pan

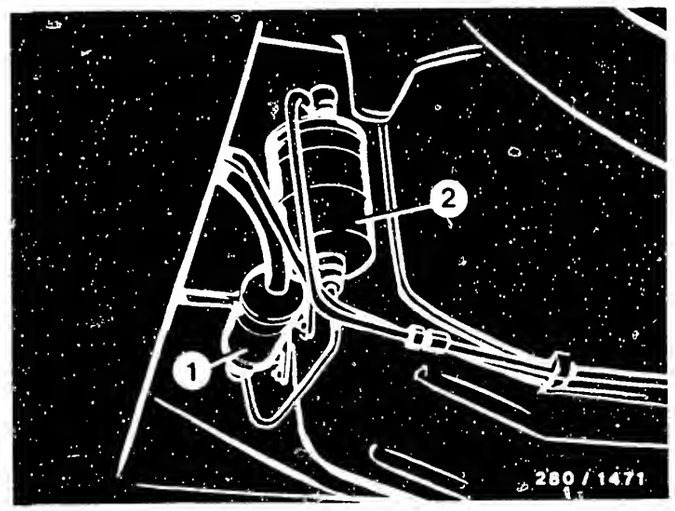
* Upper illustration
  1 = Plug-in connection, sensor signal
  2 = Plug-in connection, sensor heater

* Center illustration
  1 = Exhaust-gas catalytic converter
  2 = Heated lambda sensor

* Lower illustration
  1 = Electric fuel pump
  2 = Fuel filter







Trouble-shooting instructions : POR-5005

BOSCH system : ABS

Make of vehicle : PORSCHE

Basic microcard : PKW-040

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SPECIAL FEATURES

This microcard contains the trouble-shooting instructions, valid at the time of publication, for the following model:

Porsche 944 08.1986 ->

* ABS with 4 wheel-speed sensors and 3 hydraulic channels.
* Sensor ring gear with 45 teeth.
* 944 S and 944 Turbo only: braking-force regulator for rear axle screwed on to hydraulic modulator (connection h).

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

* For safety reasons, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.
  Exception: relays.
* Do not loosen any screws on the hydraulic modulator! Danger of fatal accident due to brake failure.
* Caution when handling brake fluid. Poisonous!

For further information, see basic instructions.

TEST REQUIREMENTS FOR TESTING WITH
ABS2 LED TESTER

* Regulatory tire size fitted?

* Check for firm seating of ground of return-supply pump.

* Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.

* Check for firm seating of ground strap between engine block and vehicle frame.

* Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).

* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).

* If the ABS warning lamp lights up constantly and does not go out, check the following points:

- Controller plug sitting correctly on controller and latched?

- All plug contacts O.K.?

- Spring contacts latched?

- Check installation position for correct seating of seal ring in controller plug, rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

  Wheel-speed sensors:
  front left to term. 6 and term. 4.
  front right to term. 11 and term. 21.
  rear left to term. 8 and term. 9.
  rear right to term. 24 and term. 26.
  rear axle to term. - and term. -.

- V-belt snapped?
  (Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).

* Connect ABS 2 LED tester to ABS wiring harness.

- Disconnect and connect controller only with ignition switched off.

- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).

- Observe LED (green) for current supply in all program-selector-switch positions.

C A U T I O N !

Do not drive with tester connected!
The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.
Repeat the complete test program after any repairs are carried out.
The Antiskid System is a vehicle safety system.
Work on the system demands detailed knowledge of the system.
The conventional brake system must be O.K.

General information for trouble-shooting:

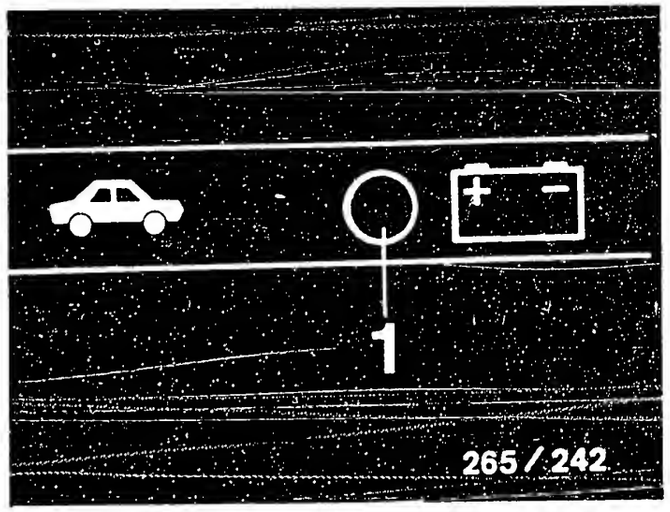
Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

RAPID DIAGNOSIS CHART

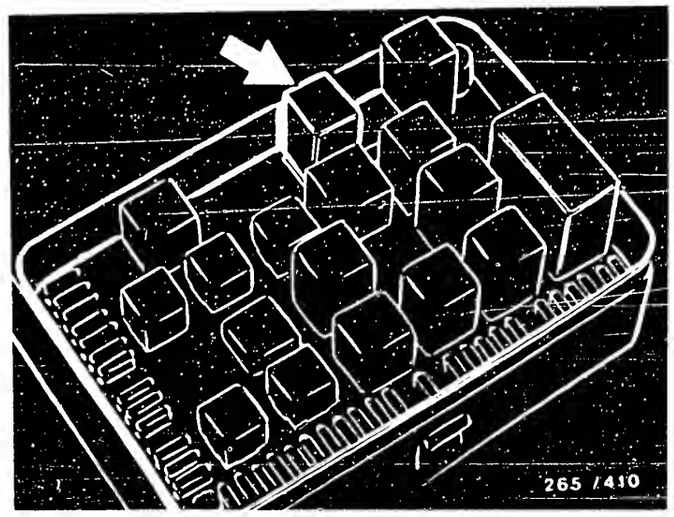
Do not drive with tester connected. Are all test conditions met?

Program-switch positions 1 to 6

Testing of (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of faults
Power supply (term.1 und term.20)	Ignition on	LED 1 (top picture) continuously lit	*Battery insufficiently charged *High voltage drops *Overvoltage-protection relay defective *Check lead to driving switch term.15



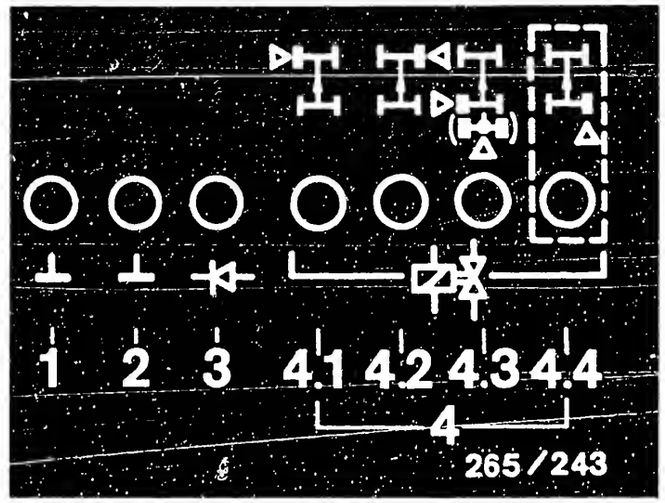
Arrow = Overvoltage-protection relay



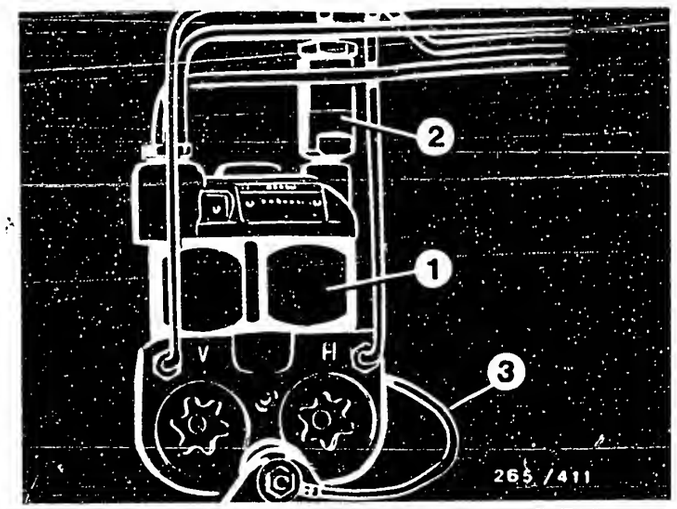
RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 1 (3-channel hydraulic modulator)

Testing of (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of faults
Ground connection (term.10, term.34) Diode for warning lamp (term.29, term.32) Solenoid-operated valve internal res. (term.2, term.18, term.-, term.35) Off-position and ground connection of relay ABS warning lamp	Ignition on	6 LED (1 to 4.3) simultaneously brightly lit (top picture) ABS warning lamp in vehicle must light up	* LED 1 and/or 2 (top picture) not lit: Check ground terminals for open circuit. * LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay. * One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid-operated valve and leads. Solenoid-operated valve internal resistance 0,7...1,7 Ω * All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective. * Dimmer lighting-up of an LED means contact resistance in the corresponding circuit. * ABS warning lamp not lit: Warning lamp defective. Note: all other 5 LEDs lit.

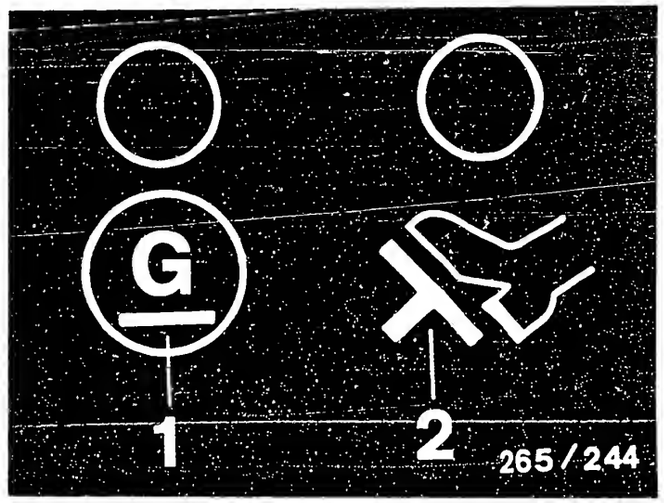


1 = Hydraulic modulator
2 = Braking-force regulator
3 = Ground cable



RAPID DIAGNOSIS CHART (CONTINUED)

Program-switch position 2

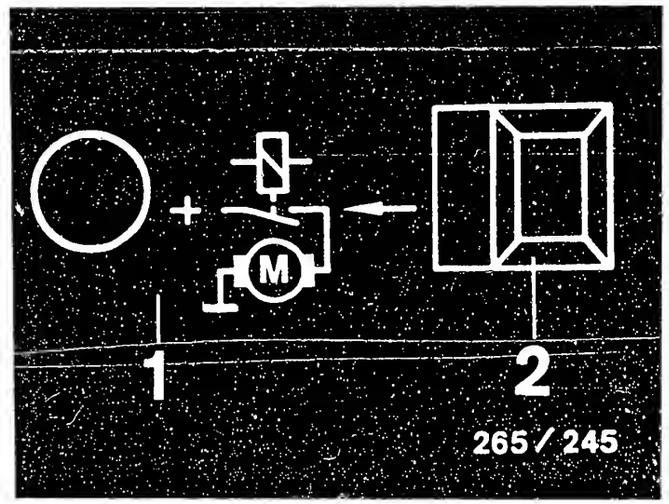


Testing of (Measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of faults
Alternator voltage from term.61 (term.15)	Ignition on	LED 1 (top picture) lit.	* In some cases, LED does not go out until after burst of throttle (test is O.K. in this case).
	Start engine	LED 1 (top picture) goes out when engine running	* Check lead to alternator term.61 * Alternator defective.
Stop-lamp switch (term.25)	Ignition on	LED 2 (top picture) lit	* Stop-lamp switch defective. * Check lead to stop-lamp switch.
	Press brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to to stop-lamp switch.

RAPID DIAGNOSIS CHART (CONTINUED)

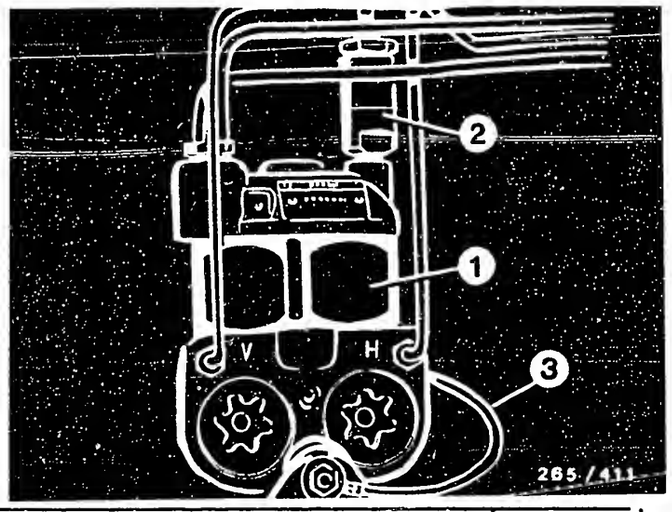
Program–selector–switch position 3

Under test (measurement at the terminals)	Additional operation	Test specifications (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.14 and term.28)	Ignition on, constantly press push-button 2 (upper illustration)	LED 1 lights up, pump motor runs. After releasing push-button, LED stays lit due to run-on of motor (upper illustration).	* Motor relay defective * Check frame connection and positive terminal of pump motor * Check following leads: from controller term. 14 and term. 28 to hydraulic modulator term. 9 or term. 11. Positive lead to hydraulic modulator term. 10. * Pump motor or hydraulic modulator defective.



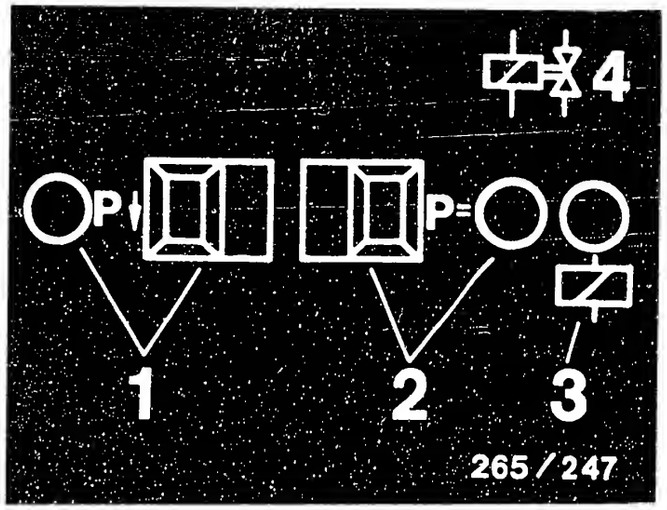
Program–selector–switch position 4 not applicable.

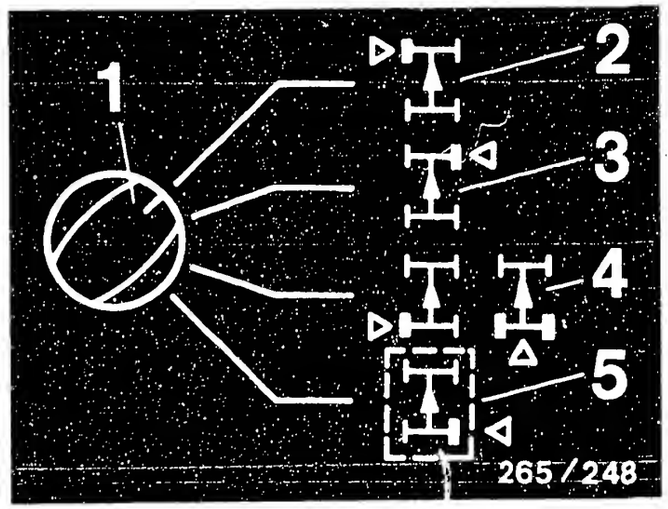
1 = Hydraulic modulator
2 = Braking–force regulator
3 = Ground cable

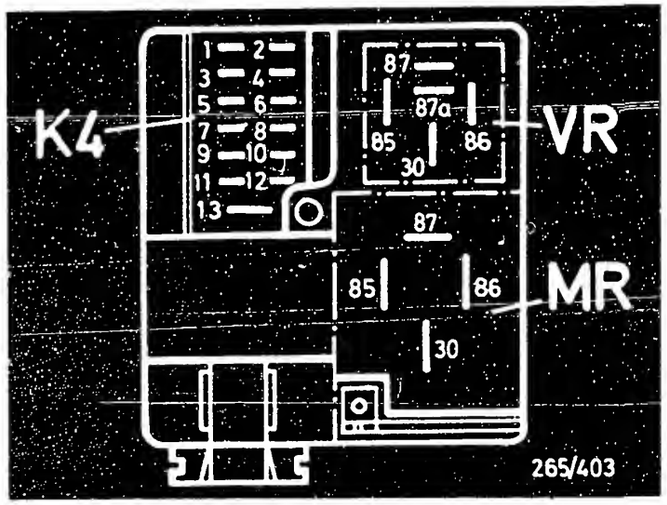


RAPID DIAGNOSIS CHART (CONTINUED)
Program-selector-switch position 5 (3-channel hydraulic modulator)

Test (measurement at terminals)	Additional operator action	Test specification (indication)	Possible fault causes
Valve-relay operation (term. 27)	Ignition on	LED 3 (upper illustration) lights up	*Valve relay (winding) or leads defective
Operation of solenoid valves in hydraulic modulator and connection correct way round. NOTE: Perform test consecutively for each wheel individually. Keep to operational sequence.	Jack up vehicle. Switch on ignition. You must be able to turn wheel under test freely by hand. Set switch 1 for wheel selection to the wheel under test. For rear axle, set to pos.4 (center illus.).		* Repeat test with engine running * Valve relay (working contact) defective * Open circuit in lead from valve relay term. 87 to B+ * Brake lines on hydraulic modulator mixed up
Pressure-holding function	1. Hold button P= (upper illus.) constantly pressed	LED P= (upper illus.) lights up	* Current value not reached (LED P arrow or P= go out; upper illustration): Battery inadequately charged. Repeat test with engine running.
	2. Hold brake pedal down constantly	Wheel can be turned by hand	
	3. Release button P= (upper illus.)	LED P= goes out (upper illus.) Wheel blocked	
Pressure-reduction function	4. Press button P arrow (upper illus.)	LED P arrow (upper illus.) lights up, wheel can be turned by hand	* Electrical connections of solenoid valves correct? Wheel front left: term.2 Wheel front right: term.35 Wheel rear left: term.- Wheel rear right: term.- Rear axle: term.18
	5. Release button P arrow (upper illus.)	LED P arrow (upper illus.) goes out, wheel blocked	* Hydraulic modulator defective
	6. Release brake pedal		



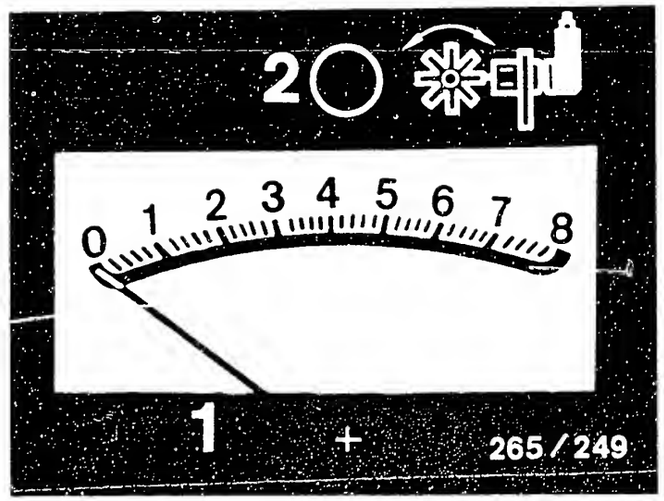


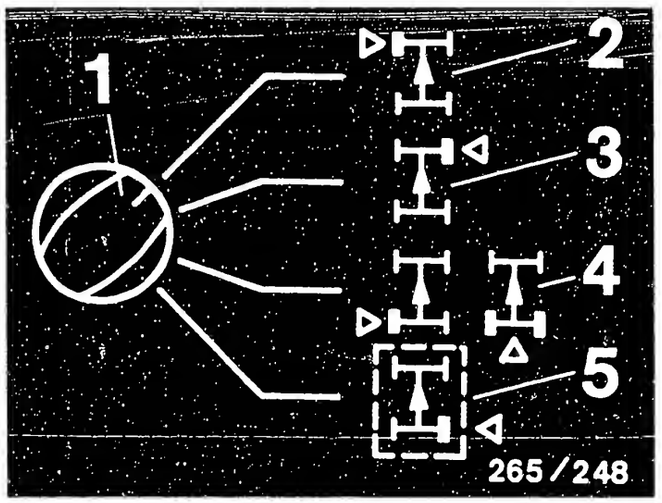


RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Wheel-speed sensor for operation and mix-up NOTE: Check each wheel separately in turn. (Wheel, front left: term.4 and term.6 Wheel, front right: term.11 and term.21 Wheel, rear left: term.8 and term.9 Wheel, rear right: term.24 and term.26)	Chock-up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. When testing the driven axle, the wheel not being tested must be locked. Set switch for wheel selection to wheel to be tested (lower illustration) Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)	1. Smallest reading larger 1,6 divisions 2. Permissible fluctuation max. 25 % of largest reading.	*Wheel-speed-sensor lead mixed up *Brake in wheel-speed-sensor lead *Wheel-speed sensor defectove Winding resistance Front axle: 0,6...1,6 k Ω Rear axle: 0,6...1,6 k Ω *Air gap between wheel-speed sensor and ring gear too wide *Ring gear defective or loose *Ring gear with incorrect number of teeth installed Front axle: 45 teeth Rear axle: 45 teeth *Wheel-bearing clearance too large *Instrument gives reading, LED 2 does not light up: loose contact in wheel-speed sensor lead.

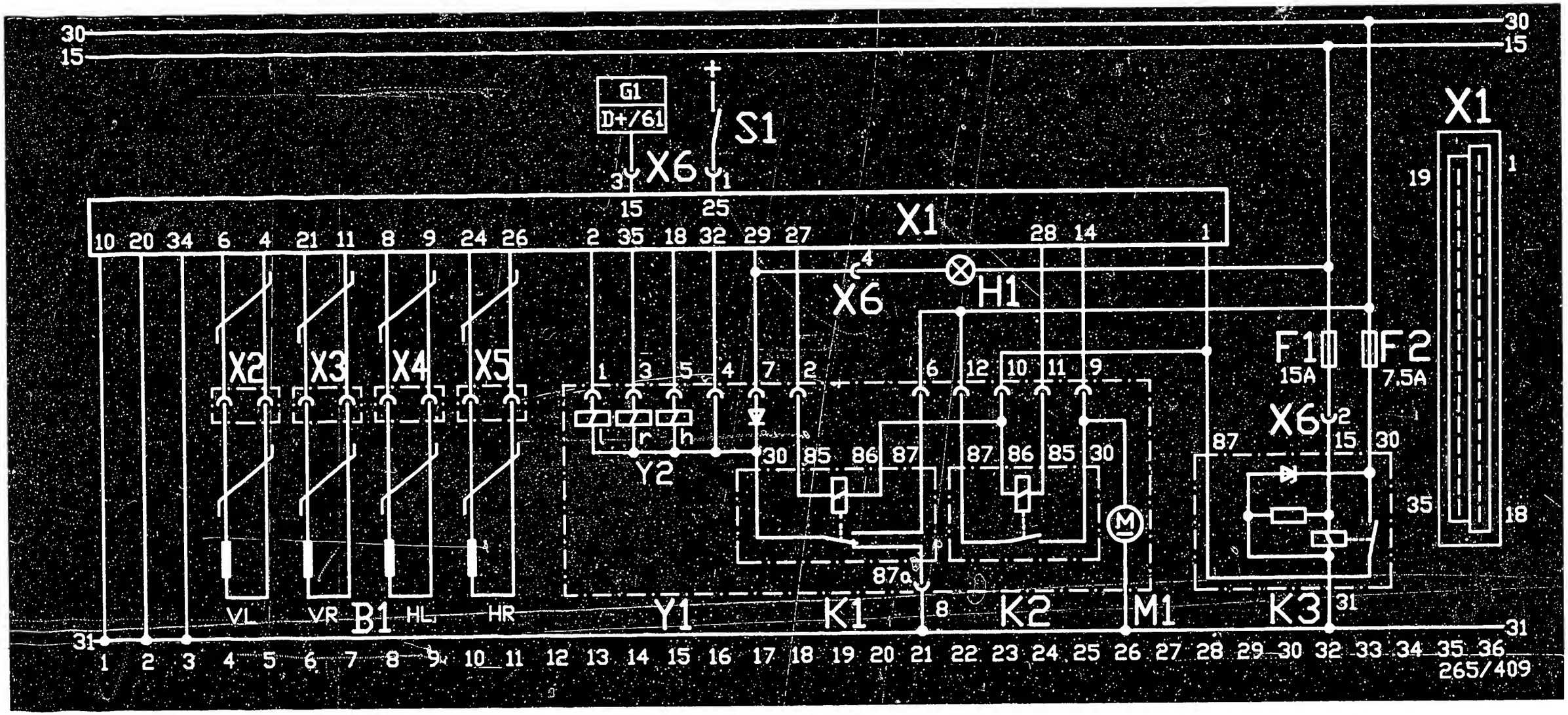




TEST SPECIFICATIONS

Wheel-speed sensor	
* Winding resistance at ambient temperature (-10°C...+120°C) for	
Front axle:	600...1600 Ω
Rear axle:	600...1600 Ω
Hydraulic-modulator solenoid-operated valves	
* Winding resistance at ambient temperature (-10°C...+120°C):	0,7...1,7 Ω
Air gap:	0,8 ± 0,5 mm
Tightening torque for	
* Fastening screws of wheel-speed sensors:	> 8 Nm
* Brake-line connections on hydraulic modulator:	12...16 Nm
Number of teeth	
* Front axle:	45 teeth
* Rear axle:	45 teeth

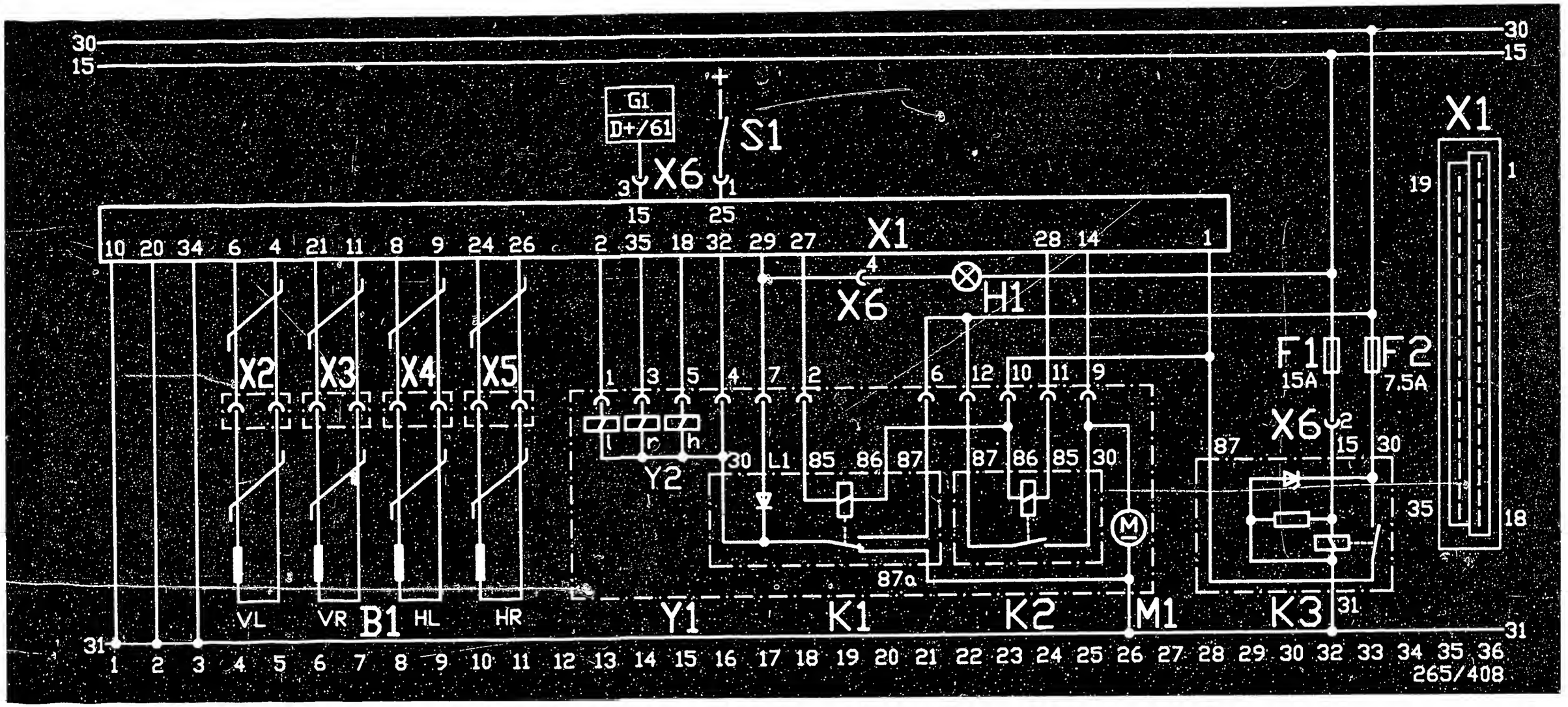
For production reasons:
continued on the following coordinate.



B1 = Wheel-speed sensor
F1 = Fuse No. 19
F2 = Fuse No. 26
G1 = To alternator
H1 = ABS warning lamp in instrument cluster
K1 = Valve relay
K2 = Motor relay
K3 = Overvoltage-protection relay
M1 = Return-supply-pump motor
S1 = Stop-lamp switch
X1 = Controller plug (35-pin)
X2...X5 = Wheel-speed-sensor plug
X6 = 4-pin plug in central electrics
Y1 = Hydraulic modulator
Y2 = Solenoid-operated valves
HL = Rear left
HR = Rear right
h = Rear axle
VL = l = Front left
VR = r = Front right

ELECTRICAL TERMINAL DIAGRAM -> 08.1987

H19 ⟹
H20 ⟺



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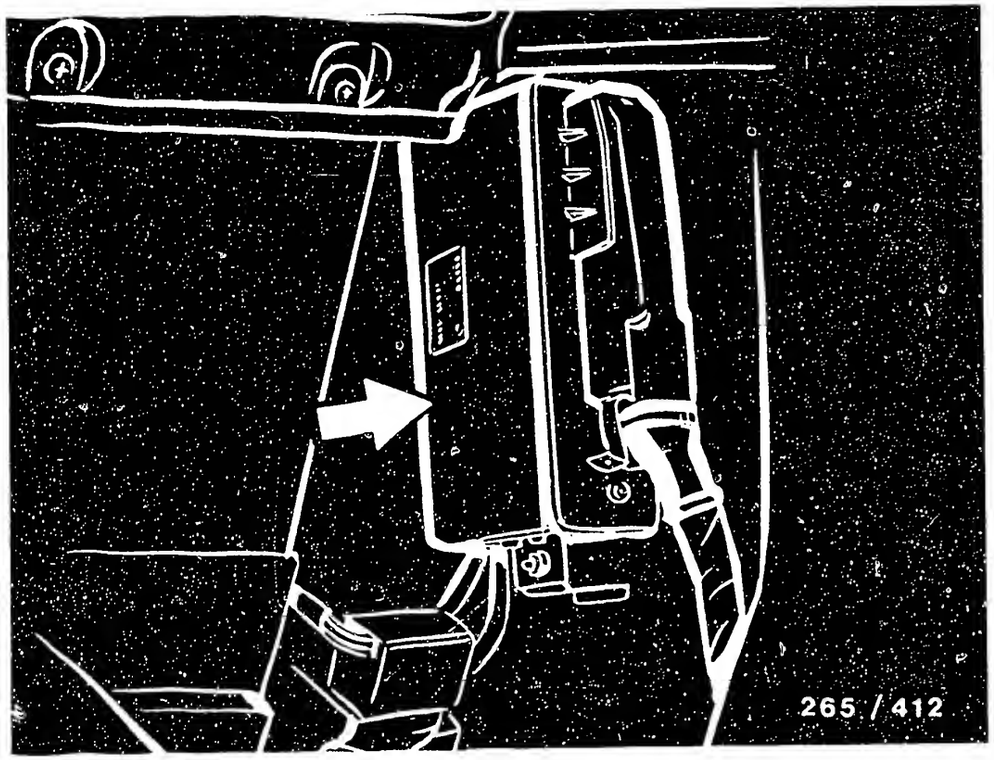
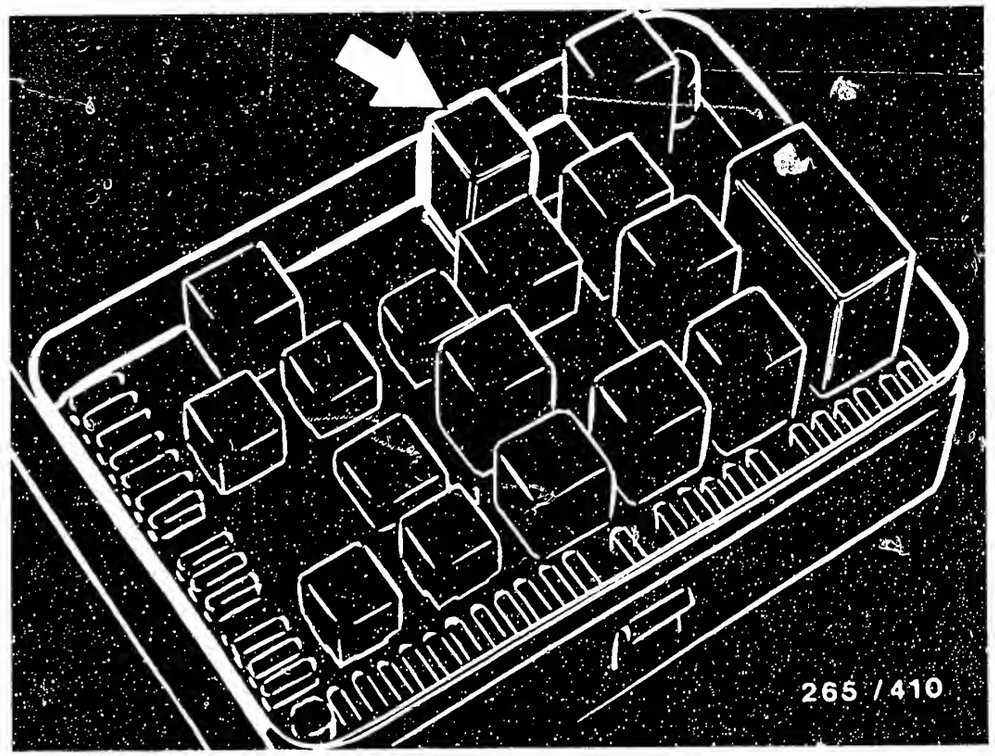
ELECTRICAL TERMINAL DIAGRAM 09.1987 ->



Arrow = ABS controller



Arrow = Overvoltage–protection relay

INSTALLATION POSITION OF COMPONENTS

The indications "right" and "left" always refer to the forward direction of travel.

* Controller:
  in the passenger–side footwell on the right.
  Remove panelling.

* ABS warning lamp:
  in the instrument cluster.

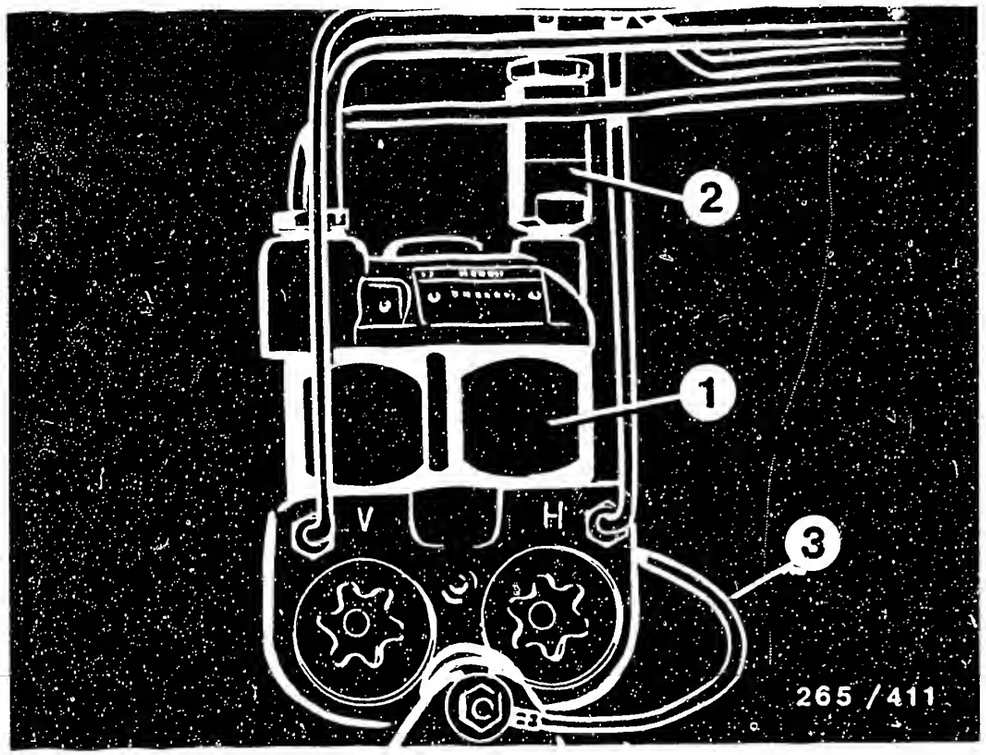
* Stop–lamp switch:
  on the brake pedal.

INSTALLATION POSITION OF COMPONENTS (Continued)

* Overvoltage–protection relay:
  in the central electrics.

* ABS fuse:
  No. 26 (7.5A) in the central electrics.

* Ground terminals:
  ground bolt at control unit,
  ground cable on hydraulic modulator,
  ground terminal of overvoltage–protection relay
  beneath the central electrics.

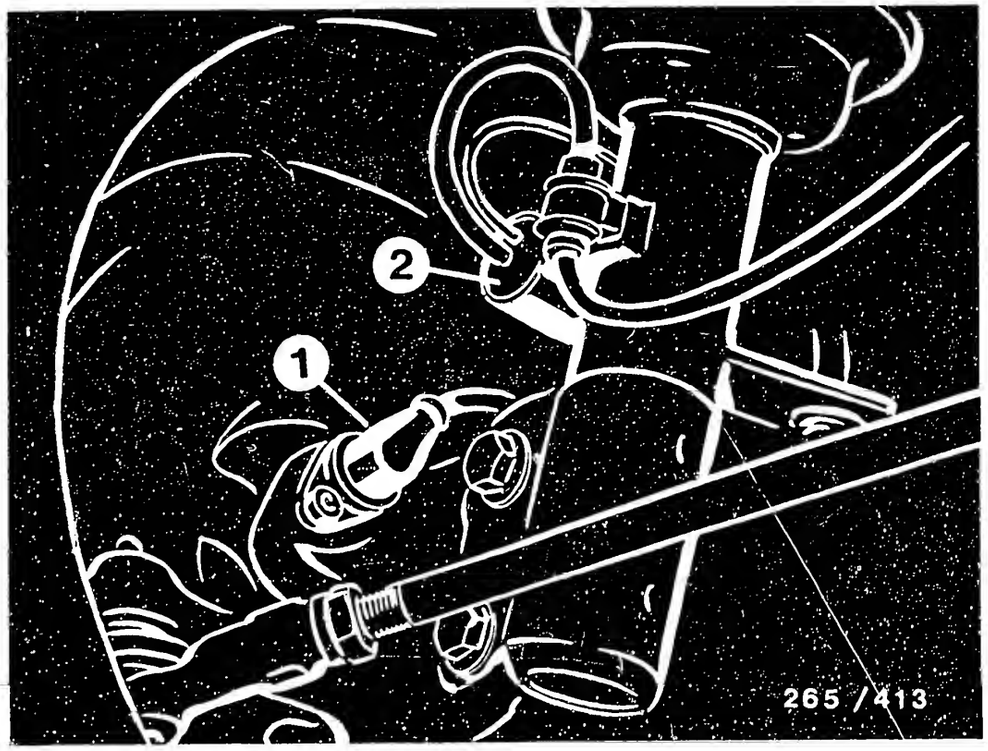


1 = Hydraulic modulator
2 = Braking-force regulator
3 = Ground cable

INSTALLATION POSITION OF COMPONENTS (Continued)

* Hydraulic modulator:
  in the front right wheel house on the rear side behind the cover.
  The hydraulic modulator must not be repaired, but be exchanged as a complete unit.
  Exception: relays may be changed.

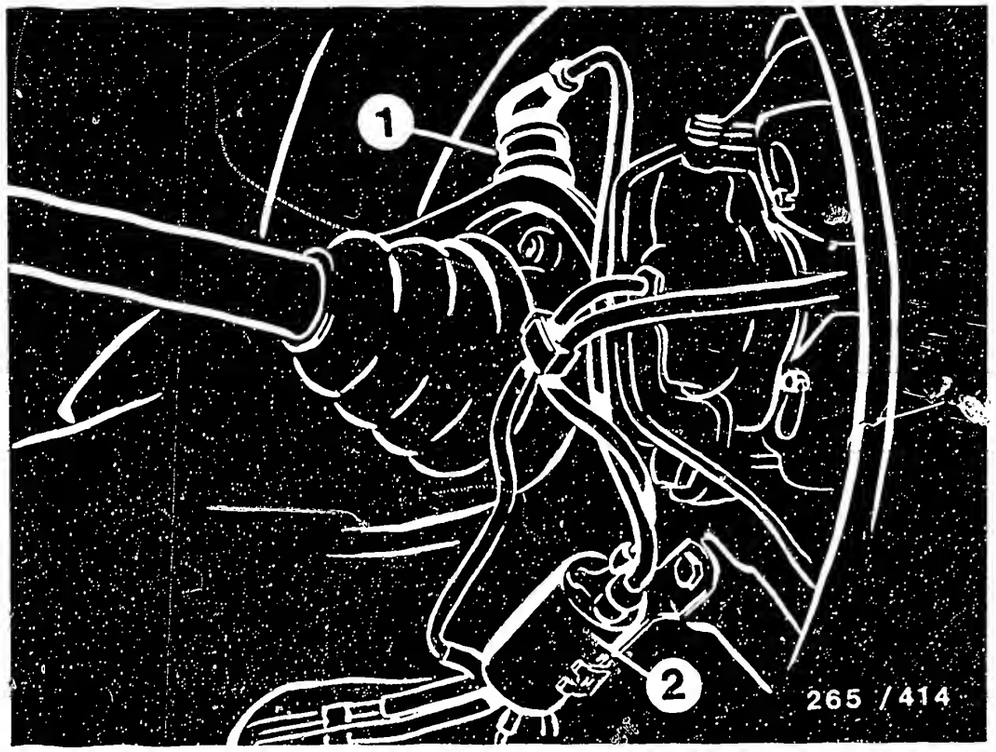
  Make sure that the brake-line connections are assigned correctly.



1 = Wheel-speed sensors, front
2 = Plug for wheel-speed-sensor and brake-lining-wear lead

INSTALLATION POSITION OF COMPONENTS (Continued)

* Wheel-speed sensors (cross pole), front axle:
  one on each side in the steering knuckles.



1 = Wheel speed sensors, rear
2 = Plug for wheel-speed sensor and brake-lining-wear lead

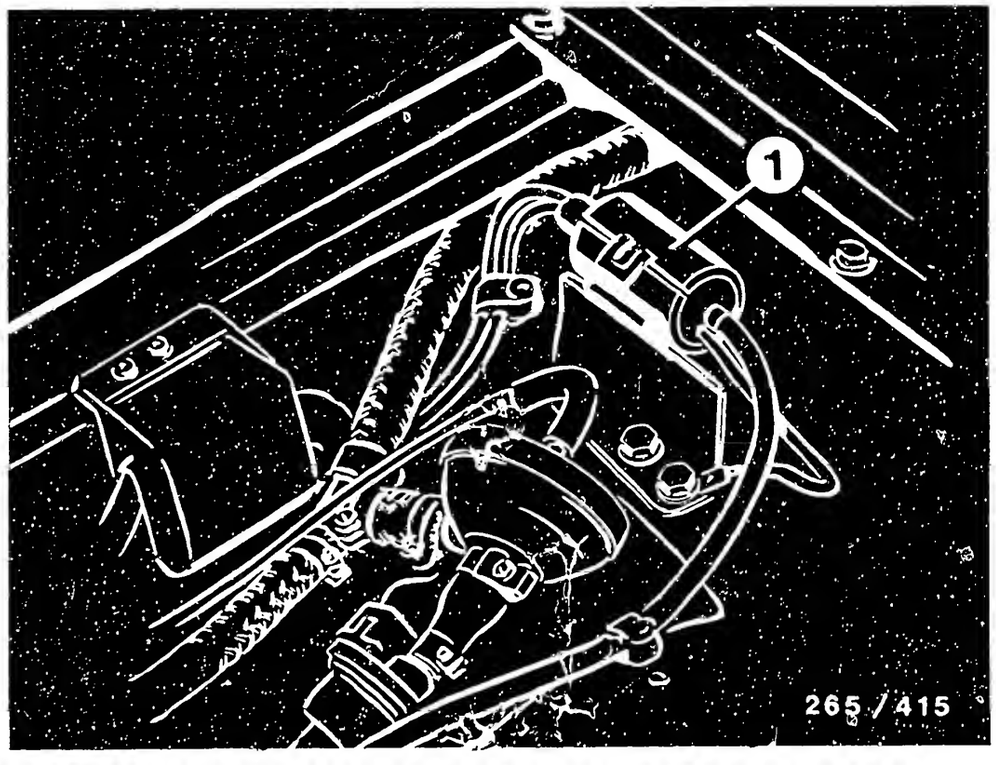
INSTALLATION POSITION OF COMPONENTS (Continued)

* Wheel-speed sensors, rear axle:
  one on each side in the rear axle link.

Wheel-speed-sensor plug-in connections:
the plug-in connections for the wheel-speed sensors and brake-lining-wear sensors are located in a common plug housing.

Each sensor is connected to the control unit via 2 plug-in connections.

The plug-in connections are moisture-resistant and clearly differentiated so that it is impossible to mix up the wheel-speed-sensor lead and the brake-lining lead.



1 = Wheel-speed-sensor plug-in connection in engine compartment

INSTALLATION POSITION OF COMPONENTS (Continued)

Plug-in connections are clipped into a sheet-metal mounting.

* Wheel-speed-sensor plug-in connections, front axle:
  one plug-in connection near to the wheel-speed sensor at the lower end of the McPherson strut, the second plug-in connection in the engine compartment.

* Wheel-speed-sensor plug-in connections, rear axle:
  one plug-in connection near to the wheel-speed sensor on the rear axle link, the second plug-in connection on the underbody.

T A B L E O F C O N T E N T S

Trouble-shooting instructions : FOR-5002

BOSCH system : KE-JETRONIC

Make of vehicle : FORD

Basic microcard : AUD-507

Test instructions	Coordinates
Special features	01
Self-diagnosis/rapid diagnosis chart	09
Test specifications	03
Electrical terminal diagram	19
Electrical safety circuit	21
Diagram of air pipes/fuel lines	23
Installation position of components	25
Removal and installation instructions	26
Important general information	27

SPECIAL FEATURES

These instructions, valid at the time of publication, cover trouble-shooting on the KE-Jetronic (system version KE 2.6) of the following vehicle models:

* FORD Escort Limousine,-Cabrio,-Turnier,
  XR 3 i - 1.6 injection (1.86 ->)

* FORD Orion 1.6 injection (9.85 ->)
  Engine: 4-cyl./ 1.6 l/ 66kW/90 bhp, with
  catalytic converter and lambda closed-loop ctrl.

- The KE-Jetronic in these models corresponds to the basic version with additional lambda closed-loop control.

- When performing trouble-shooting, it is to be noted that the KE-Jetronic and the electronic ignition system (EI-K) have some joint electrical wiring. Various electrical leads are shielded; in some cases several leads have a common shield (see terminal diagram).

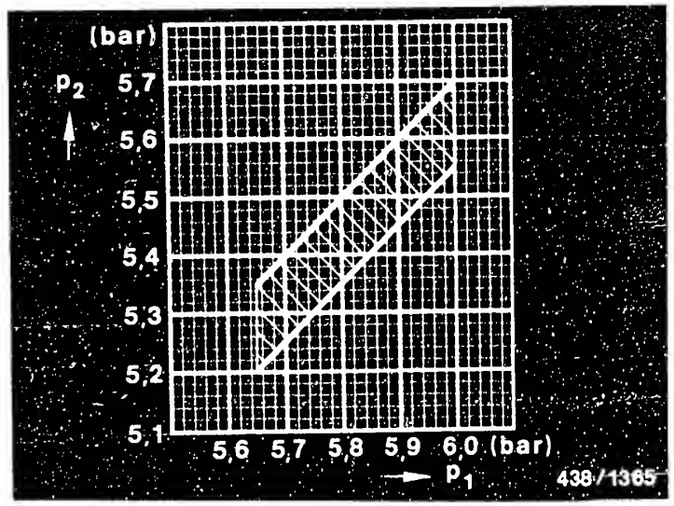
- The vehicles are equipped with a 5-pole diagnosis connection (left-hand wheel house, in area of McPherson strut).
  Pin 4 = Lambda measurement output (integrator voltage) for setting closed-loop control without universal test adapter.

Important:

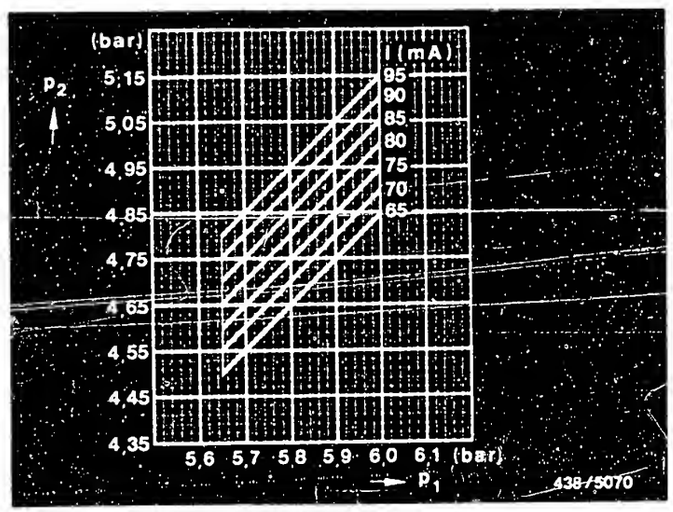
If reference is made to similar, detailed instructions (indicated on KFZ 000), it should be remembered that the test specifications are always to be taken from the vehicle-specific brief instructions.

TEST SPECIFICATIONS

No.	Test/Test conditions	Test specifications	
1	Fuel delivery – electric fuel pump:	min. 800 cm ^{3} /min	
2	Primary pressure:	5,65...6,0 bar	
3	Differential pressure: Take lower-chamber-pressure set value "warm" in accordance with measured primary pressure from upper graph. (Actuator current 10 mA) Take lower-chamber-pressure set value "cold" in accordance with measured primary pressure and actuator current from lower graph. Tolerance ± 0.15 bar. Simulation of "cold" condition: Detach connector at temperature sensor, engine.		
4	Leak test – overall system: Minimum pressure after 10 min.: Minimum pressure after 20 min.:	 2,7 bar 2,6 bar	
5	Opening pressure of injection valves:	3,0...4,1 bar	
6	Fuel-delivery comparative measurement: (Actuator current 0 mA)	Setting: (cm ^{3} /min)	Max. perm. quantity: (cm ^{3} /min)
	Idle: Part load: Full load:	6,0 40,0 100,0	6,0 40,0 109,0
	Minimum quantity with max. deflection of air-flow sensor plate:	130,0 cm ^{3} /min	



p 1 = Primary pressure
p 2 = Lower-chamber pressure



TEST SPECIFICATIONS (CONTINUED)

No.	Test/Test conditions	Test specifications	
7	Flow rate – KE–restriction:	130... 150 cm^3 /min	
8	Temperature sensor, engine (NTC):		
	Cold engine (+15...+30°C):	1,3... 3,6 k Ω	
	Engine at operating temperature (approx. +80°C):	250... 390 Ω	
9	Thermo–time switch – resistance measurement:	Below +30°C	Above +40°C
	Terminal G and ground:	25... 40 Ω	50... 80 Ω
	Terminal W and ground:	0 Ω	100...160 Ω
	Terminal G and terminal W:	25... 40 Ω	50... 80 Ω
10	Basic setting of idle–mixture–adjusting screw:		
	Fuel–distributor contact surface – needle bearing:	18,7...18,9 mm	
11	Air–flow–sensor potentiometer:		
	Voltage signal, basic setting of air–flow sensor plate	0,01...0,05 V	
12	Auxiliary–air device:		
	Resistance of heater winding:	30...65 Ω	

TEST SPECIFICATIONS (CONTINUED)

No.	Test/Test conditions	Test specifications
13	Idle-speed adjustment : *)	
	Idle speed: (Without fan operation. Adjustment at bypass screw, back of throttle-valve assembly)	875...925 min $^{-1}$
	Exhaust adjustment: (Adjust at idle-mixture-adjusting screw)	
	* Current measurement - mean-value check: - setting:	4...16 mA 9...11 mA
	* Voltage measurement - mean-value check: - mean-value setting:	Approx. 4,5 V Approx. 4,5 V
	* CO content in exhaust gas - check value:	0 vol. %

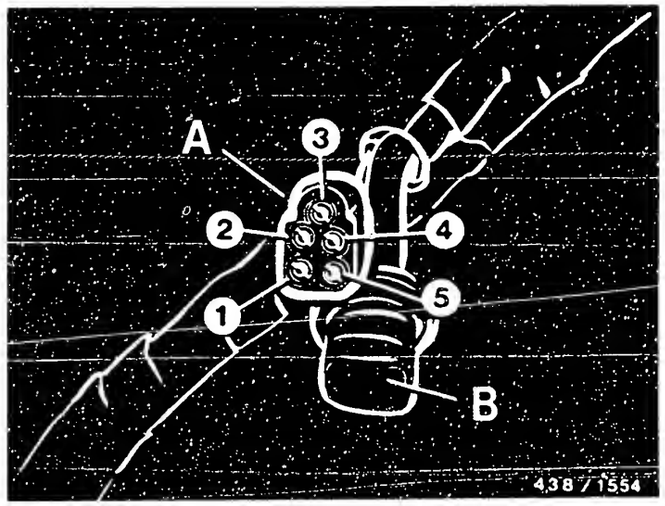
*) Information on idle-speed adjustment:

Testing and adjustment without fan operation. If necessary, briefly detach connector at temperature switch (radiator).

Exhaust-emission control is effected automatically by way of lambda closed-loop control. Test closed-loop control function with engine and exhaust system at operating temperature. Closed-loop control operation can be seen from the pulsating measured-value display. Adjustment is effected to the mean value of the pulsating measured-value display by turning the idle-mixture-adjusting screw in the mixture-control unit.

It is possible either to test the pressure-actuator control current with the universal test adapter, or alternatively, to save connecting the adapter, to measure the voltage at pin 4 (+) of the diagnosis connection (see illustration) and ground.
For voltage measurement make use of analog voltmeter with R_i =min.20 k Ω , e.g. BOSCH lambda closed-loop control tester KDJE-P 600.

CO check value is used to check whether there is a leak in the exhaust system. Perform test at exhaust tailpipe.



A = Diagnosis connection at wiring harness, left-hand wheel
B = Cap

1 = Diagnosis, ignition system
2 = Engine-speed signal (TD)
3 = Ground
4 = Lambda signal
5 = NTC signal (coolant)

For production reasons:
continued on the following coordinate.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 WITH KE2 ADAPTER CABLE 1 684 463 135 AND SUITABLE MULTIMETER:

The following rapid diagnosis chart makes it possible for the experienced Jetronic specialist to rapidly test the electrical/electronic peripheral and control-unit functions of the KE-Jetronic, including lambda closed-loop control.

Important information concerning the following rapid diagnosis chart:

The "test conditions" column specifies the test steps during which the control-unit plug must be connected or disconnected. Great care must be taken to ensure that the system is without current during all plugging and unplugging operations, i.e. the ignition must be switched off and the electrical safety circuit must not be bridged.

The "test connections" column indicates the leads in the current path for the measurement being made, with reference to the pin assignment of the control-unit plug. Any trouble-shooting that may be required will involve these leads.

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/btn V	Ω	btn	Testing of	Test connect-ions	Test conditions	Test specifications
1	| V	4	–	Pressure actuator Internal resistance (R_i)	12 – 10	Detach control-unit connector.	20...30 Ω
2	| V	5	–	Temp. sensor, engine (NTC) Internal resistance	21 – 2	Control-unit connector detached. Engine temperature +15...+30°C: approx. + 80°C:	 1.3...3.6 k Ω 250...390 Ω
3	| V	9	–	Idle throttle-valve switch	13 – 2	Caution: Ohmmeter connection Left-hand, blue socket " Ω ", black socket "V". Control-unit connector detached. Throttle valve closed: Open throttle valve by hand:	 0...10 Ω infinity Ω
4	| V	10	–	Full-load throttle-valve switch	5 – 2	Caution: Ohmmeter connection: Left-hand, blue socket " Ω ", black socket "V". Control-unit connector detached. Throttle valve closed: Completely open throttle valve by hand:	 infinity Ω 0...10 Ω
5	4	—	–	Starting signal, terminal 50	24 – 2	Control-unit connector detached. Actuate starting motor:	 8...15 V

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/btn V	Ω	btn	Testing of	Test connect-ions	Test conditions	Test specifications
6	5	—	–	TD signal, ignition	25 – 2	Control-unit connector detached. Actuate starting motor for several seconds:	Voltage value undefined
7	6	–	–	Control unit – supply	1 – 2	Control-unit connector detached. Switch on ignition.	8...15 V
8	7	–	–	Supply, potentiometer, air-flow sensor	18 – 2	Connect control unit. Switch on ignition.	7...8 V
9	8	–	–	Signal – Potentiometer, air-flow sensor	17 – 2	Control unit connected. Switch on ignition. Air-flow sensor plate in off-position: Deflect air-flow sensor plate by hand, continuous voltage increase up to max.:	 Approx. 0 V 8 V
10	14	24	–	Lambda closed-loop control Closed-loop function	23 – 2	Control unit connected. Bridge sockets 1 and 2 at test adapter. Engine at operating temperature, idling. Closed-loop control function: fluctuating voltage reading. Mean value:	 Approx. 3 V
11	–	–	1	Warm-up enrichment –20°C	12 – 12	Current measurement! Meas.-instrument connection: Negative = Black socket 1 Positive = Black socket 2 Control unit connected. Switch on ignition.	 47...67 mA

J13 — ⟺

J14 — ⟺

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/btn V	Ω	btn	Testing of	Test connect-ions	Test conditions	Test specifications
12	–	21	2	Actuator current Engine at operating temp.	12 – 12	Control unit connected. Switch on ignition.	9... 11 mA
13	–	21	2 / 4	Starting enrichment	12 – 12	Control unit connected. Switch on ignition. Keep button 2 pressed. Triggering of starting enrichment (independent of temperature) with commencement of starting (btn 4): Regulation time approx. 1 second	120...140 mA
14	–	21	1 /4	Post-start enrichment	12 – 12	Control unit connected. Switch on ignition. Keep button 1 pressed: Press button 4 and keep it pressed. Current increase to: Following brief dwell time, regulation to: Regulation time approx. 90 seconds	47... 67 mA 120...140 mA 47... 67 mA
15	–	21	1 / 6	Acceleration enrichment	12 – 12	Control unit connected. Switch on ignition. Press buttons 1 and 6 and keep them pressed. Current: Rapidly deflect air-flow sensor plate. Increase in current to: Regulation approx. 1 second to:	47... 67 mA < 120 mA 47... 67 mA
16	–	21	2	Overrun cut-off	12 – 12	Control unit connected. Reconnect ammeter (interchange positive and negative). Start engine. Hold speed n at approx.: With button 2 pressed, actuate idle throttle-valve switch. Engine "surges". Current reading during decreasing engine-speed phase:	2000 min $^{-1}$ -40...-80 mA

J15 — <⟹>

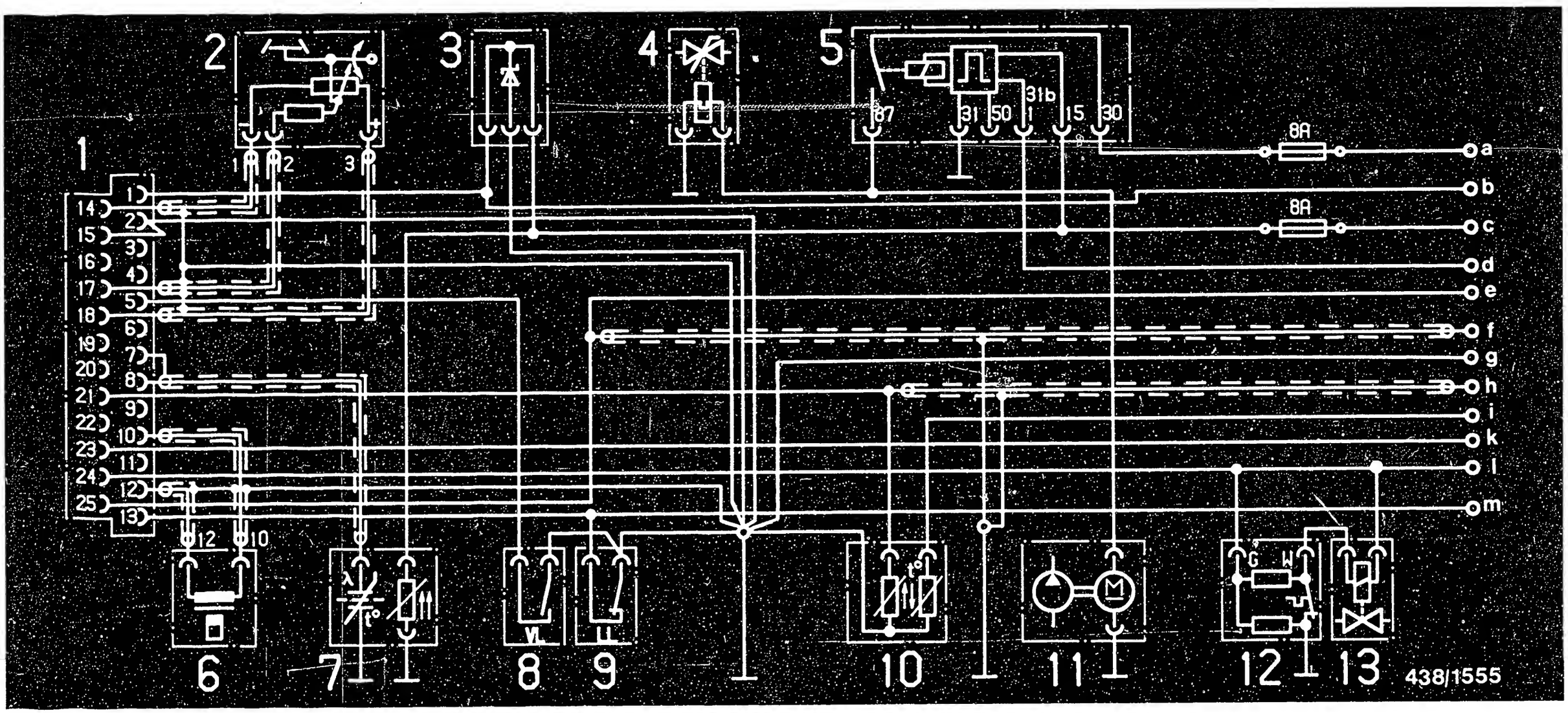
J16 — <⟹>

RAPID DIAGNOSIS CHART FOR UNIVERSAL TEST ADAPTER ETT 018.01 (CONTINUED)

No.	Switch/btn V	Ω	btn	Testing of	Test connect-ions	Test conditions	Test specifications
17	–	21	–	Rotational-speed limitation	12 – 12	Function by means of current polarity reversal as for overrun cut-off. Cut-out speed:	6300...6500 min $^{-1}$
18	–	21	–	Full-load enrichment	12 – 12	Control unit connected. Start engine. Actuate full-load throttle-valve switch by hand (at throttle-valve assembly, front). Engine-speed range up to approx. 3000 min $^{-1}$ current increase by: Engine-speed range as of approx. 3800 min $^{-1}$ further current increase by:	1... 3 mA 2... 4 mA
19	–	24	–	Lambda closed-loop control Closed-loop control function	12 – 12	Control unit connected. Engine at operating temperature, idling. Closed-loop control operation can be seen from the fluctuating current reading. Mean value: If mean value not within tolerance, adjust (idle-mixture-adjusting screw) to:	4...16 mA 9...11 mA
20	–	22	–	Lambda closed-loop control Rich stop	12 – 12	Control unit connected. Switch on ignition. Current increase to:	18...22 mA
21	–	23	–	Lambda closed-loop control Lean stop	12 – 12	Control unit connected. Switch on ignition. Current decrease to:	0... 2 mA

J17 — <==>

J18 — <==

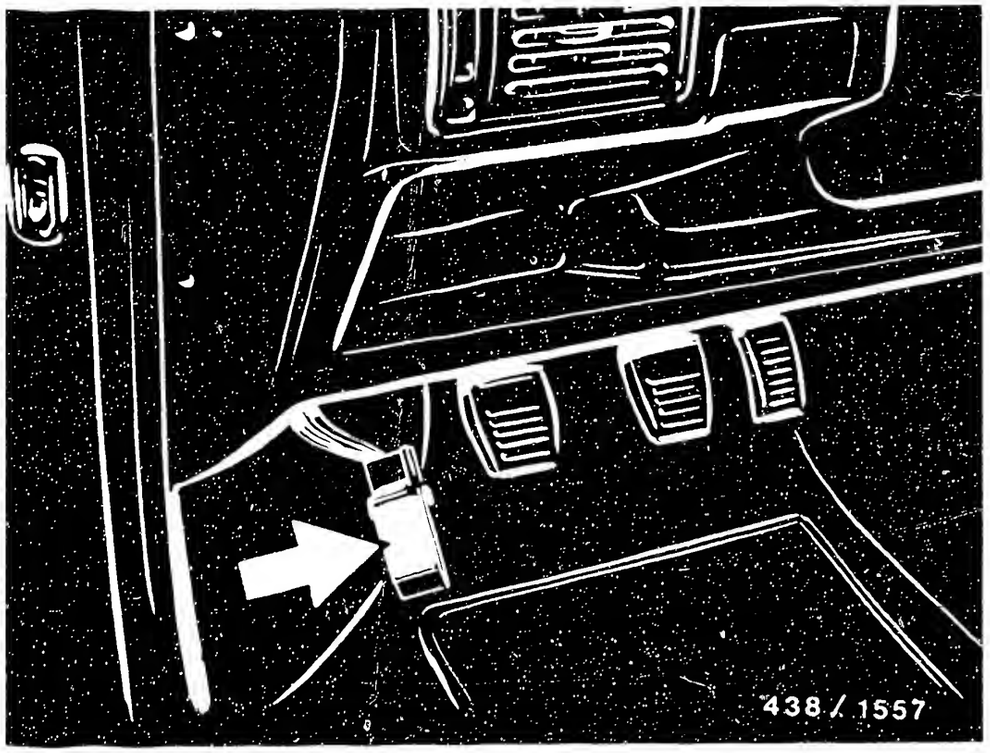


1 = KE-Jetronic control unit
2 = Air-flow-sensor potentiometer
3 = Over-voltage protection relay
4 = Auxiliary-air device
5 = Electronic engine-speed relay
6 = Electrohydraulic pressure actuator
7 = Heated lambda sensor
8 = Full-load throttle-valve switch
9 = Idle throttle-valve switch
10 = Engine temp. sensor (twin NTC)
11 = Electric fuel pump
12 = Thermo-time switch
13 = Cold-start valve

a = Terminal 30
b = Control unit, ignition, term. 6
c = Ignition switch, term. 15
d = Ignition coil, term. 1 (-)
e = Control unit, ignition, term. 17
f = Diag. plug, term. 2 (eng.-spd. signal)
g = Diagnosis plug, term. 3 (ground)
h = Diagnosis plug, term. 5 (temp. signal)
i = Control unit, ignition, term. 25
k = Diagnosis plug, term. 4 (lambda signal)
l = Ignition switch, term. 30
m = Control unit, ignition, term. 7

ELECTRICAL TERMINAL DIAGRAM WITH ELECTRIC-FUEL-PUMP SAFETY CIRCUIT

J19 ⟹ J20 ⟸



Arrow = Relay for electric fuel pump

BRIDGING SAFETY CIRCUIT

The electronic engine-speed relay for actuating the electric fuel pump is located beneath the instrument panel on the driver's side.

To bridge, remove relay from holder and detach from relay frame.

BRIDGING SAFETY CIRCUIT
(CONTINUED)

Connect connections 30 and 87 with auxiliary lead (cross-section 1.5 mm ^{2} with fuse element)

I m p o r t a n t :
Function of electric fuel pump is required only for pressure measurements.
Only switch on ignition for electrical tests.

C a u t i o n :

Never deflect (raise) air-flow sensor plate with electric fuel pump running, since otherwise fuel will be injected. Subsequently actuating the starting motor can lead to extremely severe engine damage.

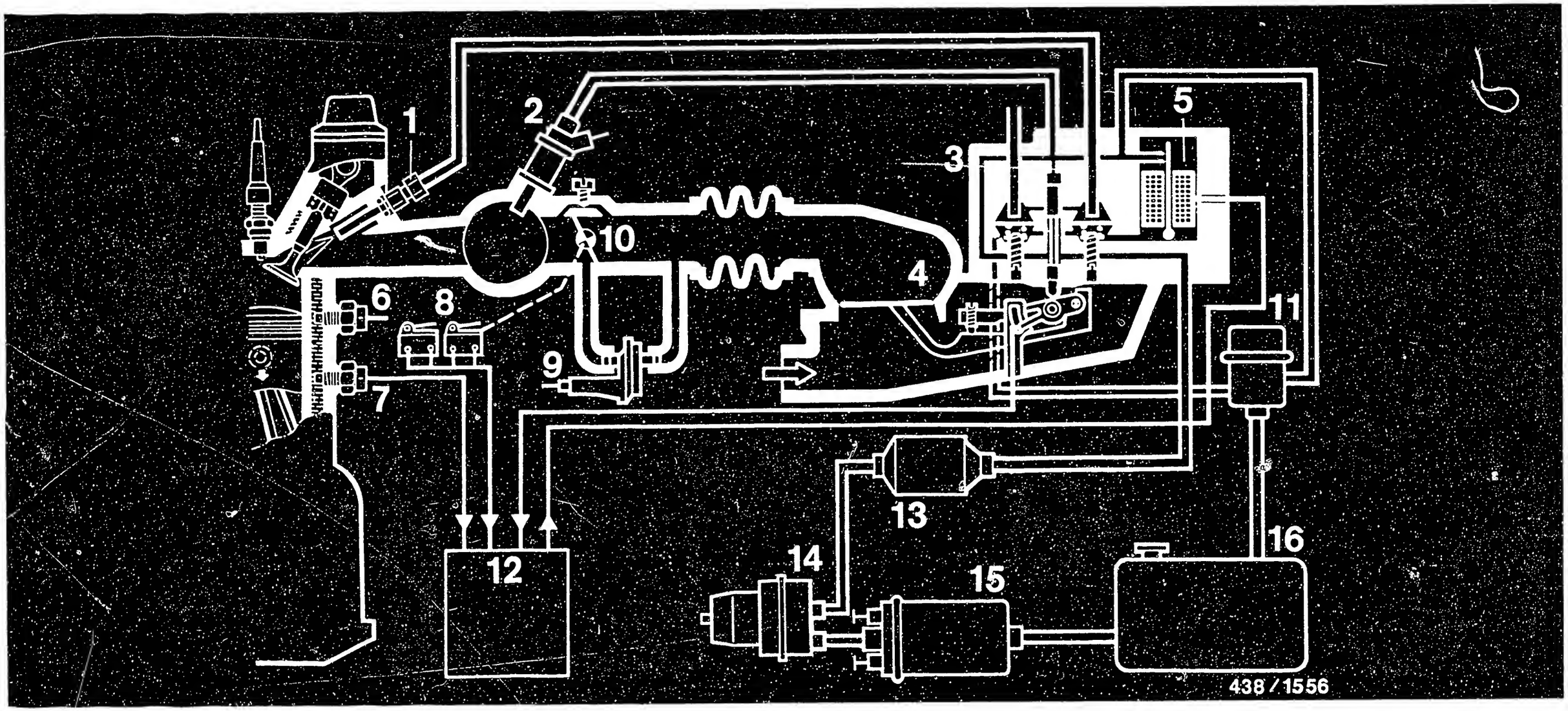


DIAGRAM OF AIR PIPES AND FUEL LINES

1 = Injection valve(s)
2 = Cold-start valve
3 = Fuel distributor
4 = Air-flow sensor
5 = Electrohydraulic pressure actuator
6 = Thermo-time switch
7 = Engine temperature sensor (twin NTC)
8 = Idle/full-load throttle-valve switches
9 = Auxiliary-air device
10 = Throttle valve
11 = Pressure regulator (primary pressure)
12 = KE-Jetronic control unit
13 = Fuel filter
14 = Fuel accumulator
15 = Electric fuel pump
16 = Fuel tank

INSTALLATION POSITION OF COMPONENTS

* Mixture-control unit: On air-filter housing, in area of left-hand, inner wheel house.

* Fuel filter: Beneath mixture-control unit.

* Fuel accumulator: On left-hand, inner wheel house; next to brake booster.

* Throttle-valve switch: At throttle-valve assembly, front. Idle switch at bottom, full-load switch at top.

* Cold-start valve: In intake manifold, in area of throttle-valve-assembly mounting flange.

* Auxiliary-air device: Beneath throttle-valve-assembly mounting flange.

* Injection valves: In flanges of intake tubes.

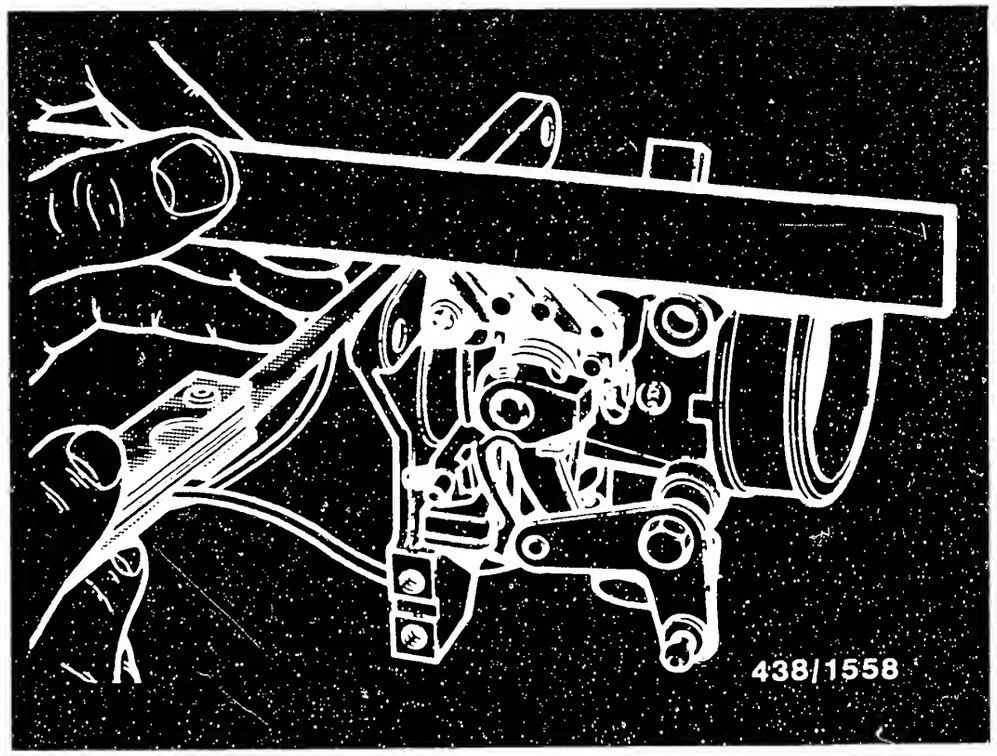
* Lambda sensor: On front side of engine, in exhaust pipe, in area of starting motor.

* KE-Jetronic control unit: The control units for ignition and KE-Jetronic (same housing designs) are located at the engine bulkhead behind the housing for the heating. The KE control unit is on the right in the direction of travel.

* Thermo-time switch, temperature sensor: Back of engine, in area above oil filter.

* Over-voltage protection relay: In central-electrics console marked with "KE".

* Electric fuel pump: Underside of vehicle in area above rear axle. A diaphragm-type pressure damping unit is provided for noise attenuation purposes at the connection on the delivery end.



REMOVAL AND INSTALLATION INFORMATION FOR IDLE/FULL-LOAD THROTTLE-VALVE SWITCHES

The two throttle-valve switches can only be replaced together on account of the joint plug connection.

Idle switch: Adjust such that switch closes with throttle valve closed and opens immediately after leaving the throttle-valve closed position.

Full-load switch: Prior to removal, place ruler on top edge of switch and use feeler gauge to measure distance between ruler and throttle-valve-assembly mounting flange (illustration).

Set new switch to dimension determined. Ensure that switch closes when throttle-plate lever reaches full-load position.

IMPORTANT GENERAL INFORMATION

* Never deflect (raise) sensor plate of air-flow sensor when performing tests with electric fuel pump running since this causes fuel to be injected. Such action can lead to extremely severe engine damage when the engine is subsequently started.

* Observe regulations concerning test equipment when testing injection valves with valve tester. Never perform test with fuel intended for driving or with other readily flammable liquids.
  The local safety regulations are likewise to be observed when using testing fuel.

* Only perform leak test on engine intake system with permitted leakage detection spray (e.g. Gypoflex). Never use readily flammable liquids. Observe local safety regulations.

* Never start engine when battery is not properly connected and never disconnect battery from vehicle electrical system with engine running.

* Disconnect battery from vehicle electrical system when carrying out fast charging.

* Electronic control units are to be removed in the event of temperatures above 80°C (e.g. drying stove). This likewise applies when performing electric welding work (e.g. spot welding).

* Make sure all wiring-harness connectors are properly attached.

* Never detach or attach connectors of electronic control unit with ignition switched on.

For production reasons:
continued on the following coordinate.

T A B L E O F C O N T E N T S

Trouble-shooting instructions : MB-5035

BOSCH system : Airbag 3

Make of vehicle : MERCEDES-BENZ

Basic microcard : PKW-098

Section	Coordinate
Special features, safety, usage	02
Trouble-shooting chart	04
Self-diagnosis	05
Test specifications	11
Electrical terminal diagram	13
Installation position of components	15

SPECIAL FEATURES

* This microcard, valid at the time of publication, contains the trouble-shooting instructions for the airbag installed as special equipment in the following MERCEDES-BENZ models:
  190...560 SEL (09.87 ->)

* The airbag trigger unit is equipped with self-diagnosis. Should a fault occur in the system, this fault is stored in the fault memory.
  The RS-/SRS warning lamp in the instrument panel lights up as long as the fault is present in the system.
  The RS-/SRS warning lamp goes out as soon as the fault is no longer present.
  The fault memory is not however cleared.
  Faults, which are stored in the fault memory and not indicated by way of the RS/SRS warning lamp, are sporadic faults (loose contacts).
* The fault times (in time units of 5 minutes) and the crash profile are likewise stored in the fault memory. These data can be interrogated by the manufacturer via the built-in diagnosis interface using a tester (diagnosis tester) in the event of claims for damages.
* The power stand-by and voltage transformer are integrated into the airbag trigger unit.
* The airbag 3 is installed in two versions, with or without passenger-side airbag.
* The airbag trigger unit makes use of variable trigger thresholds.
  The airbag is triggered at low impact speeds or higher impact speeds depending on whether the driver and front passenger are wearing seatbelts.
* The seat contact informs the trigger unit as to whether the front-passenger seat in the vehicle is occupied.
  The passenger-side airbag is only triggered if the front passenger seat is occupied.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the airbag system, be sure to observe the safety and precautionary measures in the basic instructions.

* C A U T I O N !
  Do not disconnect any plug-in connection of the airbag system when the ignition is switched on and the battery connected. Take measurements only at the plug terminals specified.

  When testing the system, use only multimeters with current limitation $\leq$ 20 mA , since otherwise it is not possible to fully ensure that the airbag will not be triggered by mistake; that is, that the operation of the pellets is altered.

  For further precautionary measures, see basic instructions.

TROUBLE-SHOOTING CHART

Customer complaint (symptoms of trouble)

1. RS/SRS warning lamp lights up constantly	2. RS/SRS warning lamp does not light up when ignition is switched on.	3. Interference noise when steering	4. Seat-belt retractor not functioning or causes interference noise	5. RS/SRS warning lamp lights up intermittently for approx. 10 s (e.g. after starting)	6. Seat-belt tightener not functioning	Cause (component fault)
*	*	*	*	*	*	Evaluate self-diagnosis
	*					RS/SRS warning lamp defective
		*				Check transmission collector rings to firing pellet on driver's side
				*		Check voltage supply
					*	Check seat-belt-tightener firing circuits
			*			Check seat-belt retractor

HOW TO USE THE SELF-DIAGNOSIS, SELF-DIAGNOSIS TEST TABLE

RS/SRS warning lamp (fault lamp)
RS/SRS warning lamp in instrument panel lights up for approx. 4 seconds when the ignition is switched on.

1. RS/SRS warning lamp goes out after approx. 4 seconds if there is no fault present in the electrical system at that moment.
2. RS/SRS warning lamp does not go out or fault lamp lights up continuously or intermittently while driving: evaluate flashing code.
3. RS/SRS warning lamp lights up if there is a brief voltage dip < 9 V for at least 10 seconds (no storage of fault).

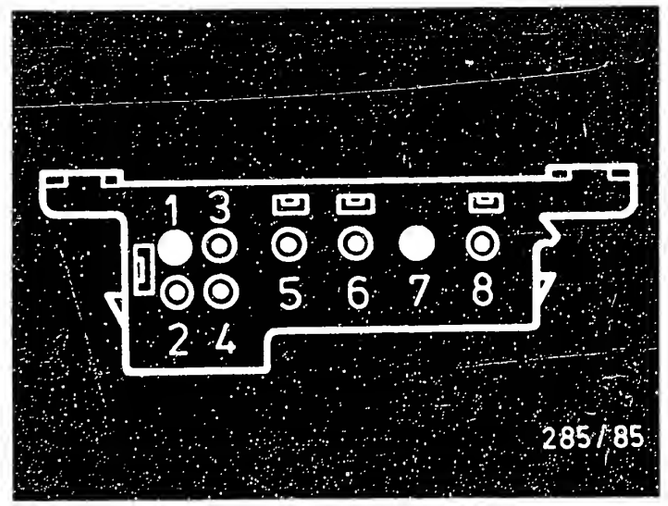
Activation of self-diagnosis:
Connect evaluation unit for flashing code KDAW 9980 socket 2 and socket 4 to test coupling for diagnosis (top picture) socket 6. Connect evaluation unit socket 1 to positive U_B and socket 3 to ground (socket 1 to diagnosis coupling) (LED on KDAW 9980 may flicker). Switch on ignition and wait for at least 15 seconds. Press button on evaluation unit for approx. 2 s. Output of the self-diagnosis commences approx. 2 s following stimulation with the first flashing code. The fault memory can be read out as often as desired.

Evaluation of flashing code (bottom picture):
The flashing code for each fault consists of a flashing-pulse block. Each block represents a number and consists of between 1 and 10 pulses. One pulse corresponds to the number 1, ten pulses correspond to the number 10. The fault lamp lights up briefly with each pulse.

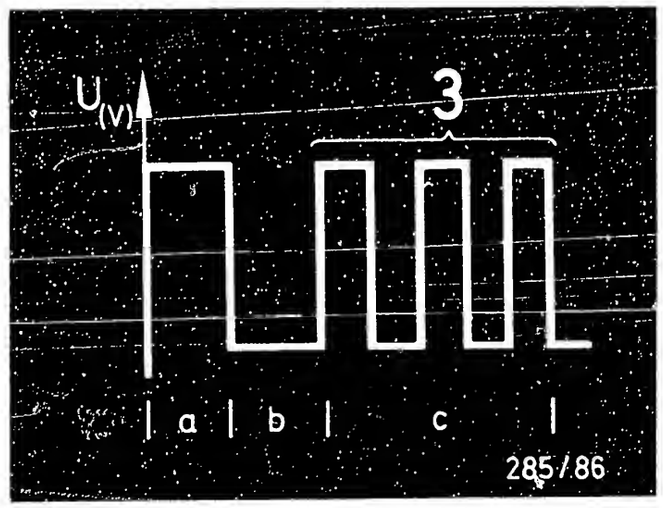
Continuing with diagnosis:
Once a fault has been read out, the next fault is output by renewed pressing of the button. Continue with the diagnosis until the fault read out first is repeated. The diagnosis output can only be terminated by switching off the ignition.

Clearing the fault memory:
The fault memory can only be cleared if it has been read out beforehand. The stored faults must be cleared individually. The fault memory is cleared by pressing the button on the evaluation unit for 7 seconds.

N o t e : Repeat read-out of self-diagnosis following clearance procedure. Fault memory has been cleared if only the flashing code 1 is output.



a = Stimulation
b = Pause prior to output of flashing code
c = Example, flashing code 3



SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Component	Cause of trouble	Test instructions with test specifications	Terminals	Set values
1	Airbag system		No fault present in electronic system.	—	—
2	Trigger unit	Defective	Renew trigger unit.	—	—
3	Firing circuit, driver's side	Short-circuit/ low impedance or open-circuit/high impedance	Check firing circuit on driver's side at 10 pole test coupling in passenger-side footwell: (In doing so, turn steering wheel as far as it will go to left and right) Check leads for short-circuit and open-circuit (airbag unit plug detached).	5 3	2... 5 Ω
4	Firing circuit 1 and firing circuit 2 on passenger's side (only for vehicles with passenger-side airbag)		Use 10 pole test coupling in pass.-side footwell to check firing circuit 1, passenger's side: to check firing circuit 2, passenger's side: Check cable connections for short-circuit to positive and ground as well as open-circuit (plugs of seat-belt tightener units detached).	6 8 6 7	2... 5 Ω 2... 5 Ω
5	Belt buckle, driver	Short-circuit to positive or ground or open-circuit	Detach plug of belt-buckle switch. Check resistance directly at pins of belt-buckle switch Driver's belt buckle open: Driver's belt buckle closed: Check leads for short-circuit and open-circuit.	 1 2 1 2	 350...450 Ω 80...120 Ω

Note: Before detaching any plug connections in the airbag system, always first switch off ignition and disconnect battery (cover ground terminal)!
Always disconnect 10 pole test coupling before performing any measurements.

SELF-DIAGNOSIS TEST TABLE (continued)

Fault indication Flashing code	Component	Cause of trouble	Test instructions with test specifications	Termin-als	Set values
6	Seat contact, front passenger	Short-circuit to positive	Detach plug of seat contact. Check resistance directly at pins of seat-contact switch No load on passenger seat: Load on passenger seat: Check leads for short-circuit and open-circuit.	 1 2 1 2	 350...450 Ω 80...120 Ω
7	Belt buckle, front passenger	Short-circuit to positive or ground or open-circuit	Detach plug of belt-buckle switch. Check resistance directly at pins of belt-buckle switch Front-passenger belt buckle open: Front-passenger belt buckle closed: Check leads for short-circuit and open-circuit.	 1 2 1 2	 350...450 Ω 80...120 Ω
8	Voltage supply	Undervoltage	Check voltage at plug of trigger unit: Check cable connections for short-circuit, contact resistances and open-circuit.	9 12	greater than 10 V
9	RS/SRS warning lamp	Short-circuit to ground or positive or open-circuit	Detach plug of airbag trigger unit. Check at plug of trigger unit with multimeter: Pay attention to notes on measurement! Note: Short-circuit to ground must have been applied for longer than 10 s. Check leads for short-circuit and open-circuit	3 12	greater than 10 V
10	Special memory	Special memory has been written	Replace trigger unit.	—	———

Note: Always switch off ignition and disconnect battery (cover ground terminal) before disconnecting any plug connections in the airbag system!
Always detach 10 pole test coupling before performing any measurements.

TEST SPECIFICATIONS:

RS/SRS warning lamp: 1,2 W

Firing pellets: 2... 5 Ω

Note: Resistors of firing circuits (term. 5 and term. 8 to term. 1, term. 13 and term. 14 to term. 2 and term. 6 to term. 2) may only be tested with a multimeter featuring current limitation < 20 mA (airbag may be triggered or change in firing behaviour of firing pellets).

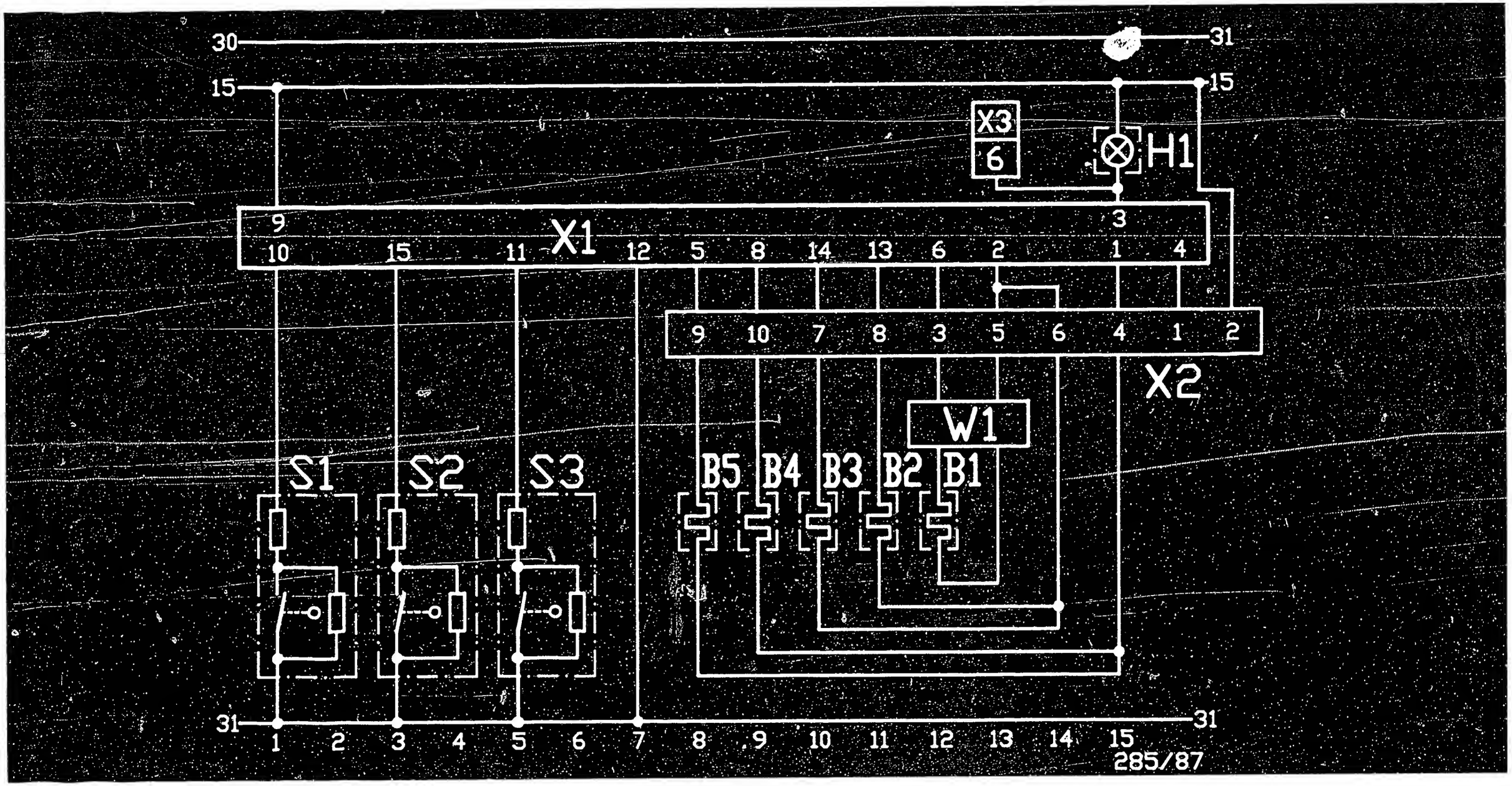
Belt-buckle switch:

Belt engaged in belt buckle: 80...120 Ω
Belt not engaged: 350...450 Ω

Passenger-seat contact:

Load on passenger seat: 80...120 Ω
No load on passenger seat: 350...450 Ω

For production reasons:
continued on the following coordinate.



B1 = Firing pellet, driver's airbag
B2 = Firing pellet 1, passenger's airbag
B3 = Firing pellet 2, passenger's airbag
B4 = Firing pellet, driver's seat-belt tighten.
B5 = Firing pellet, passenger's seat-belt tightener
H1 = RS/SRS warning lamp
S1 = Belt buckle, driver
S2 = Seat contact, passenger
S3 = Belt buckle, passenger
W1 = Collector ring
X1 = Trigger-unit plug
X2 = 10-pole test coupling Passenger-side footwell
X3 = Test coupling, diagnosis

ELECTRICAL TERMINAL DIAGRAM

K13 ⟹
K14 ⟸

INSTALLATION POSITION OF COMPONENTS

The driver's airbag unit is installed in the steering wheel.

The passenger's airbag unit is installed in the instrument panel in place of the glove compartment.
(Attached by way of a central fastening screw on the back screwed in from below).

The trigger unit (airbag 3) is attached to the transmission tunnel behind the center console.

The seat-belt tightener units are installed in the door pillars.

The belt-buckle switches are an integral part of the belt buckles.

The passenger-seat contact is integrated into the seat as a contact foil.

The RS/SRS warning lamp is installed in the instrument panel.

The diagnosis test coupling is installed in the engine compartment next to the battery.

For production reasons:
continued on the following coordinate.

Trouble-shooting instructions : AUD-5006

BOSCH system : KE-Motronic

Make of vehicle : AUDI

Basic microcard : PKW-084

TABLE OF CONTENTS

Section	Coordinates
Special features	02
Structure, usage	03
Safety and precautionary measures	04
Trouble-shooting chart	05
Self-diagnosis test table	07
Test specifications	15
Electrical terminal diagram	23
Installation position of components, notes on removal and installation	25

SPECIAL FEATURES

These trouble-shooting instructions, valid at the time of publication, apply to the following AUDI models:

AUDI 80 / AUDI 4000 USA/California,
with 2.0 l / 4-cyl. engine, 83 kW
Engine code letters 3A, Year of manufacture 09.87->

KE-Motronic, system version MK 1.1.

This system with common control unit has to a great extent the same functions as the KE 3-Jetronic with an EI-K ignition system. The fuel-injection unit corresponds exactly to that of the KE-Jetronic with regard to the mechanical and hydraulic parts of the system.

Alongside the basic functions of fuel injection and ignition, the system has further additional functions:

* Lambda closed-loop control with adaptive basic adaptation (automatic compensation of basic faults).
* Low-idle-speed control.
* Knock control.
* Electronically controlled tank ventilation.
* Self-diagnosis with fault memory.

STRUCTURE AND USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

In accordance with the customer complaint, the trouble-shooting chart leads to different causes/component faults.
For a detailed description of trouble-shooting, see the information in the trouble-shooting chart of the basic instructions.

ATTENTION: Even if reference is made to basic instructions, the set values, terminal assignments and special features of these vehicle-related brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

In order to keep persons out of danger and to avoid damage to the engine, trigger boxes and control units or to the ignition system, observe the information in the basic instructions.

CAUTION!
High-performance ignition system with dangerous primary and secondary voltages!

Touching voltage-carrying components or terminals may prove fatal (both on the primary and secondary sides).

TROUBLE-SHOOTING CHART

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Idle problems (engine speed, exhaust gas).	4. Poor throttle take-up, flat spot during acceleration.	5. Engine missing (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on.	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*	*	*	*	*	*	*	*	*	*	*	Self-diagnosis
*		*	*		*						Induction system
*	*	*	*		*			*	*		Voltage supply, control unit
*	*			*	*						Electric fuel pump
*	*	*	*				*				Air-flow sensor
*		*				*					Cold-start valve
*	*			*	*						Primary pressure
*	*	*	*	*	*	*					Differential pressure
*											Fuel system leaking
*	*	*	*	*	*		*				Injection valves
*	*	*	*		*	*					Fuel distributor
*		*			*						Throttle valve
*	*	*	*		*	*					Temperature sensor (engine)
		*	*								Throttle-valve switch (idle)
					*			*	*		Throttle-valve switch (full load)
		*	*		*						Lambda closed-loop control
*	*	*	*			*					Exhaust-gas adjustment
		*									Low-idle-speed control

TROUBLE-SHOOTING CHART (CONTINUED)

Customer complaint (fault symptoms)

1. Starting motor operates, engine fails to start or starts only with difficulty.	2. Engine starts but then dies.	3. Idle problems (engine speed, exhaust gas).	4. Poor throttle take-up, flat spot during acceleration.	5. Engine missing (ignition, injection).	6. Maximum engine power/top speed not reached.	7. Fuel consumption too high.	8. Engine running on (dieseling).	9. Engine pinging/knocking.	10. Engine overheating.	11. Fault lamp.	Cause (component fault)
*											Starting enrichment
	*										Post-start enrichment
	*	*	*								Warm-up enrichment
			*								Acceleration enrichment
			*		*					*	Full-load enrichment
						*					Overrun cut-off
							*				Tank-ventilation system
*				*							Ignition high-voltage side
*				*							Ignition coil
*		*									Firing order
*											Voltage, magnetic pulse generator
*											Magn. pulse generator, operation
*											Control-unit operation, ignition
*											Voltage, trigger box
*											Primary signal
				*							Voltage, ignition coil
*											Ignition distributor - installation adjustment
*					*	*	*	*	*	*	Basic ignition setting

SELF-DIAGNOSIS TEST TABLE

Fault indication Flashing code	Testing of component/function	Test instructions/ test conditions	Terminals	Set values
1 1 1 1	Control unit	This fault is indicated by steady lighting of the diagnostic lamp while the vehicle is being driven. Exchange control unit without any further testing.	— —	— —
2 1 1 3	Magnetic pulse generator defective or open circuit between control unit and magnetic pulse generator	Engine cannot be started. Switch on ignition. Voltage measurement at cable connector of ignition distributor: Test sensor signal (idle speed):	3 1 (+)(-) 2 1	at least 10 V Rectangular pulse
	Air-flow sensor plate sticks in rest position	It may be possible to start the engine. Check centring and freedom of movement of air-flow sensor plate.	— —	— —
2 1 2 1	Idle-speed throttle-valve switch or lead defective	Idle-speed throttle-valve switch constantly closed. Lead to ECU terminal 28 is short-circuited to ground. Switch setting incorrect. Resistance measurement at plug: throttle valve closed: throttle valve open : Setting of switching point:	1 2	Approx. 0 Ω Infinity Ω 0.15 ... 0.5 mm
2 1 2 3	Full-load throttle-valve switch or lead defective	Full-load throttle-valve switch constantly closed. Lead to ECU terminal 31 is short-circuited to ground. Setting incorrect. Resistance measurement at plug: throttle valve closed: throttle valve open : Setting of switching point:	2 3	Infinity Ω Approx. 0 Ω 8 ... 12° before full load

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

Fault indication Flashing code	Testing of component/function	Test instructions/ test conditions	Termin-als	Set values
2 1 4 1	Knock-control limit reached.	As engine knock occurs, spark-advance angle is retarded by a specific amount and then subsequently advanced again slowly. Diagnostic lamp lights during the period of maximum retardation. Check basic ignition setting and correct if necessary. Test specification: Setting: Idle adjustment incorrect. Further possible causes: fuel quality, shielded lead of knock sensor damaged, engine damage.	 — — — —	 4...8° before TDC 5...7° before TDC
2 1 4 2	Knock sensor defective or open circuit in lead or contact resistance	Fault detection as of an engine speed of approx. 2650min $^{-1}$. After time lag, a steady lighting of diagnostic lamp until engine is switched off. Check leads from control unit to knock-sensor plug-in connection for open circuit: Check cable connector of knock sensor for short circuit to ground: Tightening torque, knock sensor:	 6 1 8 2 8 3 1 2 — —	 Approx. 0 Ω Approx. 0 Ω Approx. 0 Ω Infinity Ω 15...25 Nm
2 2 3 1	Low-idle-speed control not within the operating range	Possible causes: Basic adjustment of throttle valve. Induction system (e.g. unmetered air). Basic ignition setting incorrect.	— —	— —

SELF–DIAGNOSIS TEST TABLE (CONTINUED)

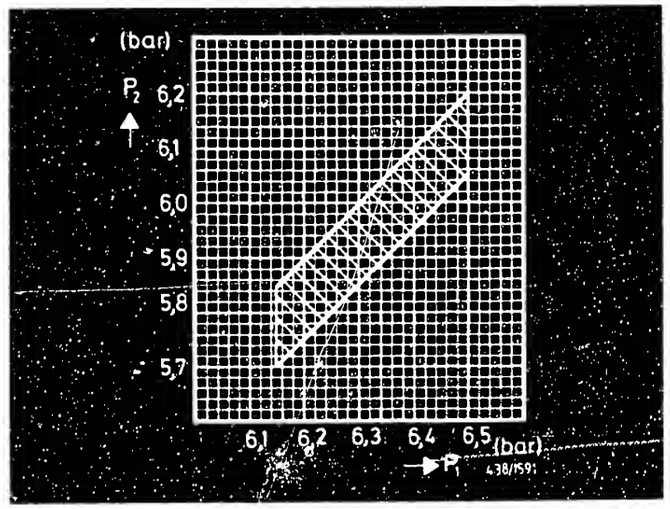
Fault indication Flashing code	Testing of component/function	Test instructions/ test conditions	Termin-als	Set values
2 2 3 2	Potentiometer in air–flow sensor defective or open circuit in lead	Voltage measurements at cable connector of potentiometer (with auxiliary leads). Switch on ignition.		
		Supply:	1 3	4.35 ... 5.35 V
		Signal (deflect air–flow sensor plate):	2 3 (+) (–)	Voltage increase
		Disconnect control–unit plug and test leads 8, 23 and 26 to plug of potentiometer for:		
		* Open circuit:	8 3	Approx. 0 Ω
			23 2	Approx. 0 Ω
			26 1	Approx. 0 Ω
		* Short circuit to ground:	8,23,26	Infinity Ω
2 3 1 2	Temperature sensor (engine) or lead defective	Check resistance value at temperature sensor (NTC):		
		Engine cold (+15 ...+30° C):	— —	1300...3600 Ω
		Engine at normal operating temperature (+80°C):	— —	250... 390 Ω
		Check leads from control unit to NTC for:		
		* Open circuit:	3–NTC	Approx. 0 Ω
			8–NTC	Approx. 0 Ω
		* Short circuit to ground:	3, 8	Infinity Ω
2 3 4 1	Lambda closed–loop control not within operating range (control limits exceeded or fallen below)	Fault occurs only in idle/part–load range.	— —	— —
		Indicated by diagnostic lamp if fault has been present for at least 2 minutes.		
		Possible causes of trouble: * Lambda closed–loop control not or incorrectly functioning, short circuit in sensor lead, lambda–sensor heater defective. * Cold–start valve leaking. * Induction system leaking (unmetered air). * Tank–ventilation valve constantly open. * Idle adjustment incorrect.		

SELF-DIAGNOSIS TEST TABLE (CONTINUED)

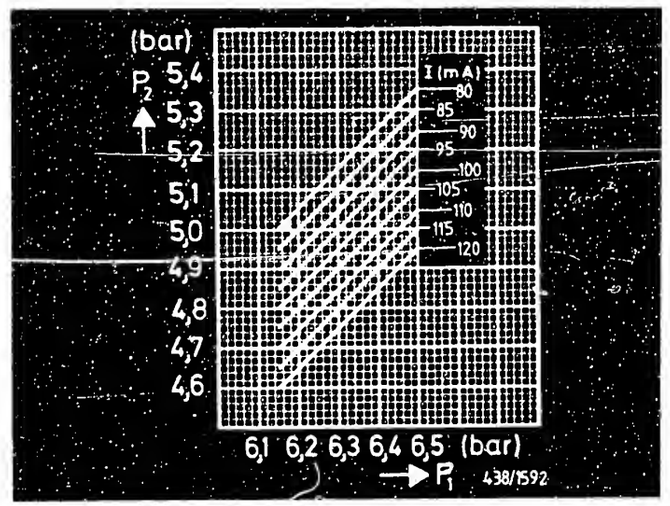
Fault indication Flashing code	Testing of component/function	Test instructions/ test conditions	Termin-als	Set values
2 3 4 2	Lambda sensor or sensor lead defective	Fault is detected when engine at normal operating temperature and in range between idle and approx. 3500 min $^{-1}$ and is indicated by diagnostic lamp. * Resistance value of lambda sensor. Cold: Hot: * Test for open circuit in lead:	 7-grnd " 7	 > 20 k Ω < 2 k Ω Approx. 0 Ω
2 3 4 3	Fuel mixture too lean (mixture control limit +10 mA exceeded).	Possible causes: * Induction system leaking (unmetered air). * Idle adjustment too lean.	— —	— —
2 3 4 4	Fuel mixture too rich (mixture control unit -5 mA fallen below).	Possible causes: * Cold-start valve leaking. * Idle adjustment too rich.	— —	— —
4 4 3 1	Low-idle-speed control not functioning	Possible causes: * Voltage supply (ignition term. 15) to idle actuator term. 2 open-circuited: * Open circuit in lead from control unit term. 17 to idle actuator term. 1 or short circuit to ground. Continuity: Short circuit to ground: * Idle actuator defective (open circuit): * Control unit defective, replace.	 2-grnd 17 2 17-grnd 1 2	 Battery voltage Approx. 0 Ω Infinity Ω 4...12 Ω
4 4 4 4	No fault detected	——— ———	— —	— —

TEST SPECIFICATIONS

NO.	Testing/Test condition	Set value	
1	Electric fuel pump – fuel delivery: Supply voltage (under load):	At least 1000 cm ^{3} /min At least 11,5 V	
2	Primary pressure:	6,15...6,5 bar	
3	Differential pressure: Take lower-chamber-pressure "warm" set value corresponding to the primary pressure measured from the top chart (actuator current 0 mA) Take lower-chamber-pressure "cold" set value corresponding to primary pressure and actuator current measured from bottom chart (tolerance ± 0.15 bar) Simulation of "cold" condition: Switch on ignition (peak coil current approx. 100 mA).		
4	Rate of flow, KE restriction:	130...150 cm ^{3} /min	
5	Leakage test – complete system: Minimum pressure after 10 mins: Minimum pressure after 20 mins:	 3,3 bar 3,2 bar	
6	Injection valves – opening pressure:	3,7...4,8 bar	
7	Fuel distributor – comparative measurement of fuel deliveries Actuator current 0 mA: Idle: Part load: Full load: Minimum delivery at max. deflection of air-flow sensor plate:	Setting (cm ^{3} /min) 6,0 40,0 100,0 120...150 cm ^{3}	Max. permiss. delivery (cm ^{3} /min) 6,6 42,5 109,0
8	Air-flow sensor plate – zero position (under basic position):	1,9...3,0 mm	
9	Air-flow sensor plate – travel:	0,1...2,0 mm	



p 1 = Primary pressure
p 2 = Lower-chamber pressure
I = Actuator



TEST SPECIFICATIONS (CONTINUED)

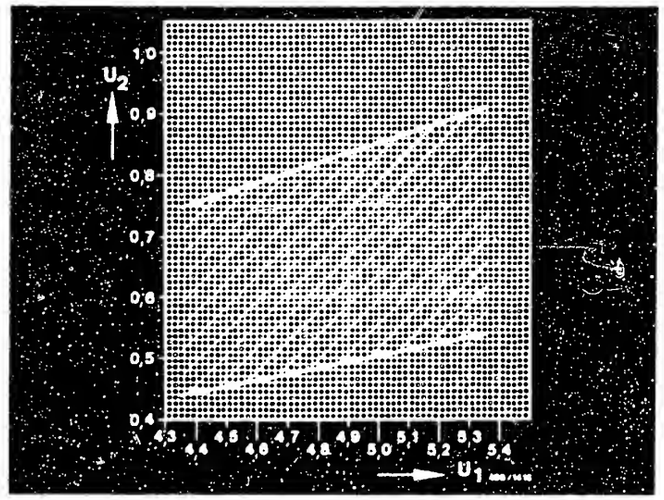
No.	Testing/Test condition	Set value
10	Idle-mixture-adjusting screw - basic setting dimension:	18,7...18,9 mm
11	Throttle-valve switch - switching-point settings: Idle switch - clearance, lever to stop: Full-load switch - switching point before full-load stop:	 0,15...0,5 mm 8... 12°
12	Resistance value, cold-start valve:	6...14 Ω
13	Resistance value, idle actuator:	4...12 Ω
14	Resistance value, tank-ventilation valves (both):	35...55 Ω
15	Resistance value, pressure actuator:	16...22 Ω
16	Resistance value, lambda-sensor heater:	1...15 Ω
17	Resistance value, fuel-temperature sensor (NTC): Engine cold (+15°C ... +30°C): Engine at norm. op. temp. (approx. +80°C):	 1300...3600 Ω 250... 390 Ω
18	Potentiometer in air-flow sensor (basic function) Supply voltage: Volt. signal; air-flow sensor plate in netral pos.: Voltage signal; air-flow sensor plate deflected: Check potentiometer setting if necessary:	 4,35...5,35 V 0...0,2 V Voltage increase See test specification No. 30
19	Test control-unit functions - injection unit: Peak coil current: Starting enrichment - engine at normal operating temperature: Post-start enrichment (corresp. to +20°C): * Start engine. Current value: * Current value constant for: * Afterwards, slow regulation to: Warm-up enrichment (corresp. to +20°C), lambda sensor disconnected, idle speed:	 85...115 mA 55... 65 mA 15... 23 mA 3... 6 s 9... 11 mA 9... 11 mA

TEST SPECIFICATIONS (CONTINUED)

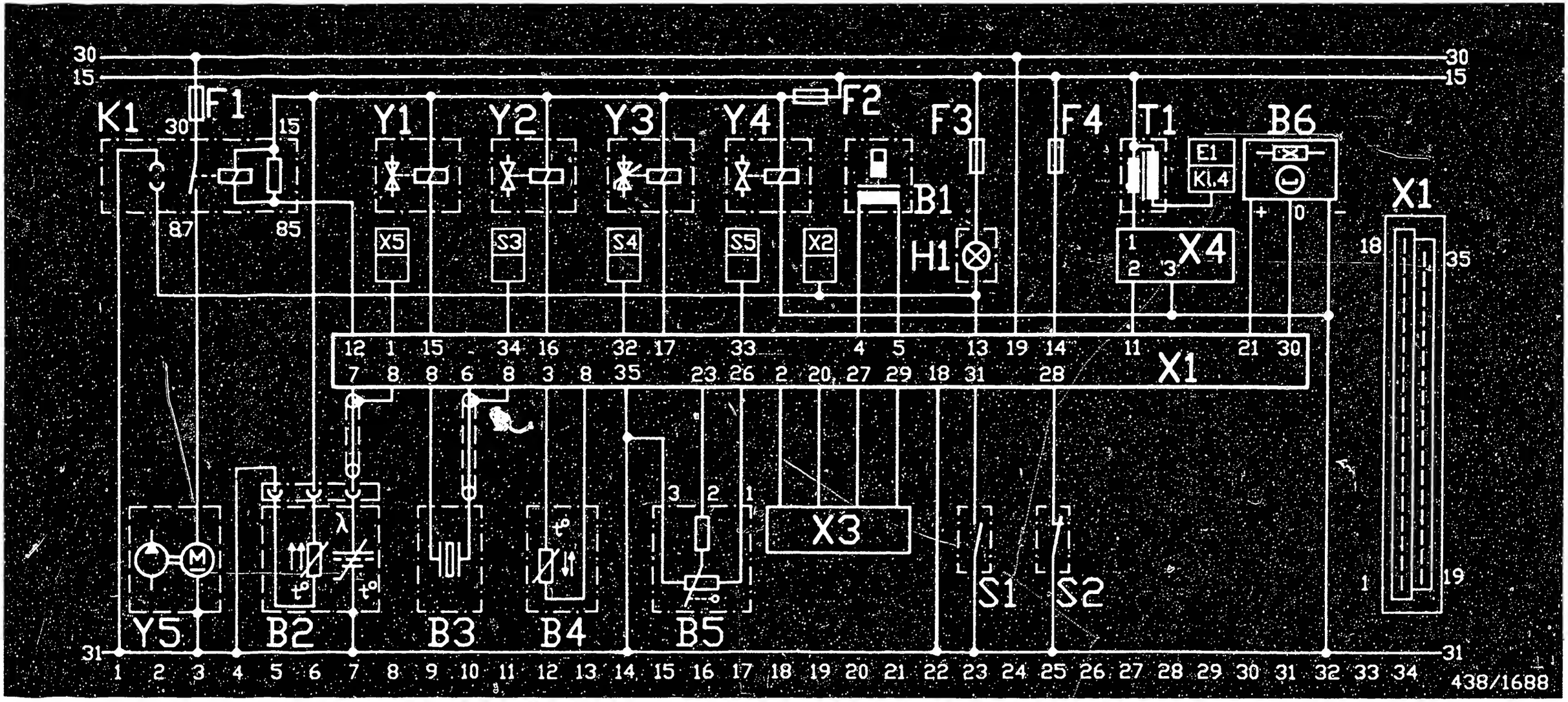
No.	Testing/Test condition	Set value
	Test control-unit functions – injection unit (continued):	
	Acceleration enrichment (corresp. to +20°C):	Current increase
	Full-load enrichment (engine at norm. op. temp.):	2...5 mA
	Overrun cut-off (engine at norm. op. temp.):	-40...-80 mA
20	Lambda closed-loop control:	
	Open-loop-control operation Switch off ignition. Disconnect negative terminal from battery and reconnect after 1 minute (this serves to clear memory). Disconnect lambda sensor. Start engine:	-1...+1 mA (static)
	Rich stop (sensor lead to ground) (heavily over-enriched, engine may stall):	Max. 23 mA
	Lean stop (sensor lead to 1.5 V) (excessively lean, engine may stall):	Max. -16 mA
	Closed-loop-control op. (lambda sensor connected):	0...5 mA (pulsating)
21	Resistance value, lambda sensor. Cold: Hot:	> 20 k Ω < 2 k Ω
22	Ignition coil – resistance values: Primary: Secondary	0,6...1,0 Ω 6,4...11,1k Ω
23	Control-unit function – ignition at idle speed:	Rectangular pulse
24	Voltage supply, trigger box (output stage):	Battery voltage
25	Voltage supply, ignition coil under load:	At least 10 V
26	Ignition – basic setting: Test specification: Setting:	4...8° before TDC 5...7° before TDC

TEST SPECIFICATIONS (CONTINUED)

No.	Testing/Test condition	Set value
27	Knock sensor – tightening torque:	15...25 Nm
28	Firing order:	1 – 3 – 4 – 2
29	Idle adjustment: Test and setting conditions: * First of all eliminate all faults detected by self-diagnosis. * Exhaust system between cylinder head and catalytic converter must be absolutely leak-tight * Basic ignition setting O.K. * If resetting necessary: remove closure cap from activated-carbon canister, pull off crankcase hose from cylinder head and breather housing and seal off. Idle-speed check value (not adjustable): Speed increase with air conditioner "on" by: CO check value (not adjustable): Pressure-actuator activation current in closed-loop control operation	 780...900 min $^{-1}$ Approx. 70 min $^{-1}$ 0,3...1,2 by vol. % 0...5 mA
30	Signal of potentiometer in air-flow sensor (measurement necessary only if poor idle or part-load performance): Measure supply voltage at potentiometer term. 1 (+) and 3 (–) and note down: Measure voltage signal of potentiometer at term. 2 (+) and 3 (–) with engine at normal operating temperature and at idle speed and compare with chart opposite.	 4,35...5,35 V See chart



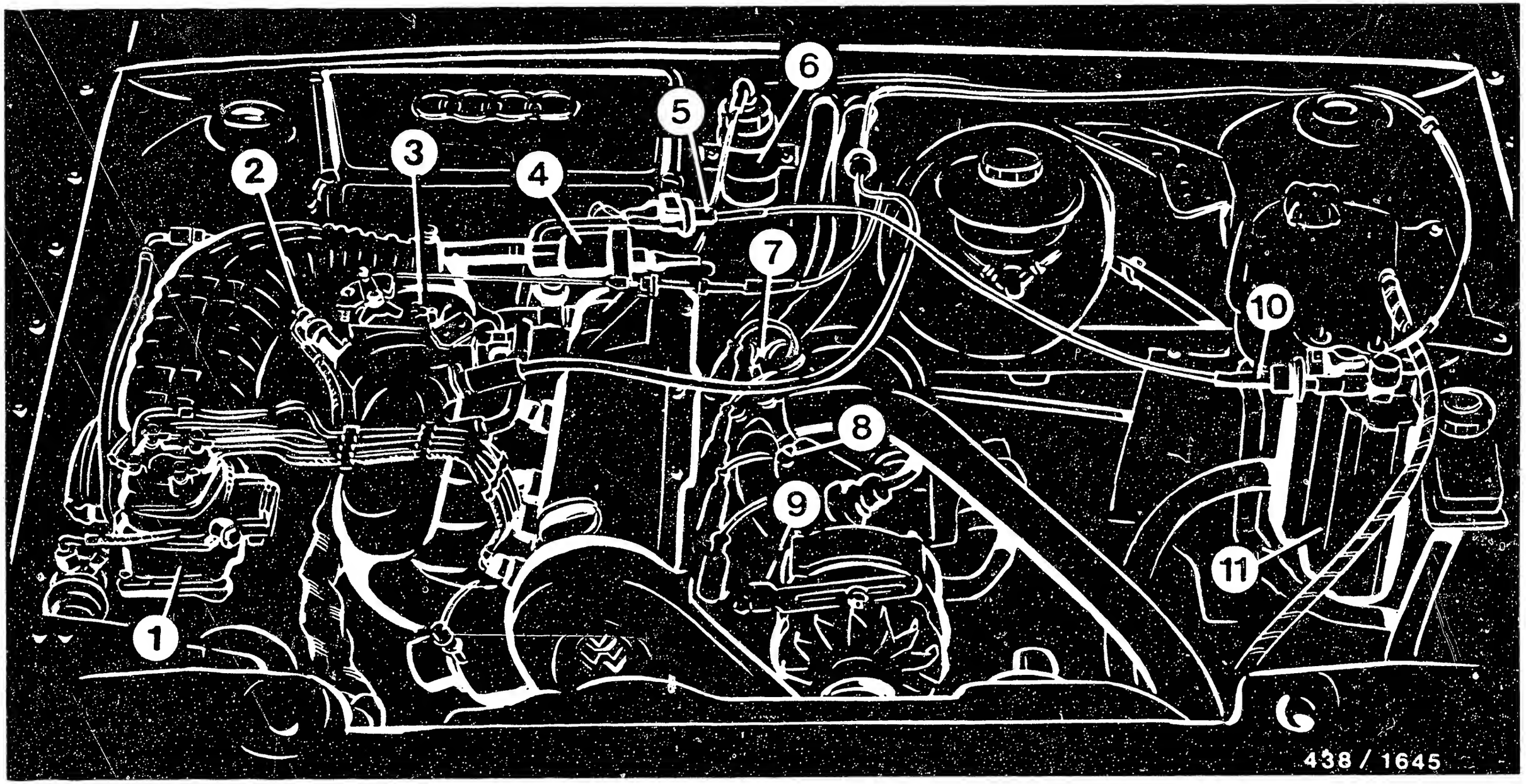
U_1 = Supply voltage, potentiometer
U_2 = Potentiometer voltage signal



B1 = Pressure actuator
B2 = Lambda sensor
B3 = Knock sensor
B4 = Temperature sensor (engine)
B5 = Air-flow-sensor potentiometer
B6 = Hall generator
E1 = Ignition distributor
F1 = 15 A fuse
F2 = 15 A fuse
F3 = 15 A fuse
F4 = 10 A fuse
H1 = Diagnostic lamp (California model only)
K1 = Electric-fuel-pump relay with contacts for triggering diagnosis
S1 = Throttle-valve switch (full load)
S2 = Throttle-valve switch (idle)
S3 = Connection, transmission switch (in vehicles (with man. shifted transm. to ground)
S4 = Connection, air-conditioner readiness
S5 = Connection, air-conditioner compressor
T1 = Ignition coil with ignition trigger box
X1 = Plug, KE control unit
X2 = Test connection, diagnosis (not California model)
X3 = Plug, parameter encoder
X4 = Plug, ignition trigger box
X5 = Connection, diagnosis interface
Y1 = Tank-ventilation valve
Y2 = Cold-start valve
Y3 = Idle actuator
Y4 = Tank-ventilation switch. valve
Y5 = Electric fuel pump

ELECTRICAL TERMINAL DIAGRAM

L23 ⟹
L24 ⟸



1 = Mixture-control unit
2 = Start valve
3 = Throttle-valve assembly with throttle-valve switch, full load (top) and idle (bottom, not visible in picture)
4 = Idle actuator
5 = Switching valve for tank ventilation
6 = Ignition coil with trigger box, output stage
7 = Ignition distributor
8 = Temperature sensor (engine)
9 = Knock sensor, on engine block, covered by alternator
10 = Tank ventilation valve (pulsed)
11 = Activated carbon filter

INSTALLATION POSITION OF COMPONENTS

L25 — ==>

L26 — <==>

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Injection valves:
  Inserted into the locating bores of the intake-manifold flanges and secured in pairs by mountings.

* KE-Motronic control unit:
  Above the footwell on the passenger's side between bulkhead and ventilation duct.

  Removal: remove trim in front of glove compartment. Push latching peg toward bulkhead and pull control unit out downwards.

* The fuel-supply components, electric fuel pump, fuel accumulator, and fuel filter:
  On the vehicle underbody on the right in the area in front of the rear axle.

* Catalytic converter and lambda sensor:
  In the exhaust system in the area behind the front axle.

When loosening and tightening joints and connections in fuel lines, make sure everything is clean and counterhold at the fixed hexagon of the respective component.

When connecting electrical cable connectors, make sure they are connected properly and spring clips are latched in tightly.

For production reasons:
continued on the following coordinate.

Trouble-shooting instructions : BMW-5015

BOSCH system : ABS

Make of vehicle : BMW

Basic microcard : PKW-040

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SPECIAL FEATURES

This microcard contains the trouble-shooting instructions valid at the time of publication for the following models:

BMW 735 i (E 32), 8.87 ->
BMW 750 i(L) (E 32), 9.87 ->

* ABS with ASR combined. One common ABS/ASR controller with 55-pin plug.
* ABS with 4 wheel-speed sensors and 4 hydraulic channels.
* Sensor ring gear with 48 teeth.
* Note: Separate instructions have been compiled for the ASR unit.

STRUCTURE, USAGE

These brief instructions encompass essentially vehicle-specific special features and test specifications (set values).

For a detailed description of trouble-shooting, see the basic instructions.

ATTENTION :
The set values, terminal assignments and special features of these vehicle-specific brief instructions are always binding.

SAFETY AND PRECAUTIONARY MEASURES

* For safety reasons, the hydraulic modulator must not be repaired, but be exchanged as a complete unit.
  Exception: relays.
* Do not loosen any screws on the hydraulic modulator! Danger of fatal accident due to brake failure.
* Caution when handling brake fluid. Poisonous!

For further information, see basic instructions.

TEST REQUIREMENTS FOR TESTING WITH
ABS2 LED TESTER

* Regulatory tire size fitted?

* Check for firm seating of ground of return-supply pump.

* Check for firm seating and corrosion of ground of overvoltage-protection relay term. 31.

* Check for firm seating of ground strap between engine block and vehicle frame.

* Check for leaks in hydraulic connections at hydraulic modulator and sealing points (visual examination).

* If the ABS warning lamp lights up intermittently when driving (e.g. after switching on loads) and goes out again by itself, check the battery and power supply (alternator, regulator and voltage drops).

* If the ABS warning lamp lights up constantly and does not go out, check the following points:

- Controller plug sitting correctly on controller and latched?

- All plug contacts O.K.?

- Spring contacts latched?

- Check installation position for correct seating of seal ring in controller plug, rounded side downward.

- Check wheel-speed-sensor leads for correct assignment at controller plug:

  Wheel-speed sensors:
  front left to term. 8 and term. 26,
  front right to term. 12 and term. 13/32 (750i),
  rear left to term. 29 and term. 30,
  rear right to term. 10 and term. 28,
  rear axle to term. - and term. -.

- V-belt snapped?
  (Alternator provides no voltage, charge-indicator lamp and ABS warning lamp light up).

* Connect ABS 2 LED tester to ABS wiring harness.

- Disconnect and connect controller only with ignition switched off.

- For testing, switch on ignition in all program-selector-switch positions (tester operates with current supply from vehicle battery).

- Observe LED (green) for current supply in all program-selector-switch positions.

C A U T I O N !

Do not drive with tester connected!
The brake system must be bled of air before the ABS test. Do not activate the ABS tester while the system is being bled.
Repeat the complete test program after any repairs are carried out.
The Antiskid System is a vehicle safety system.
Work on the system demands detailed knowledge of the system.
The conventional brake system must be O.K.

General information for trouble-shooting:

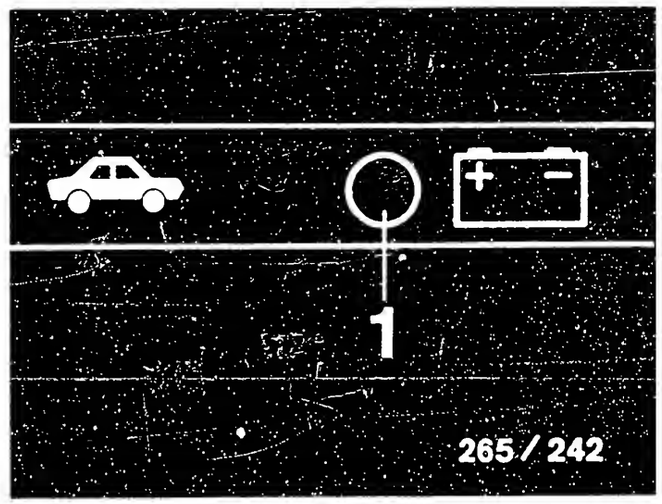
Check all leads for short circuit to ground and contact with positive leads and watch out for worn cable insulation and pinched leads.

RAPID DIAGNOSIS CHART

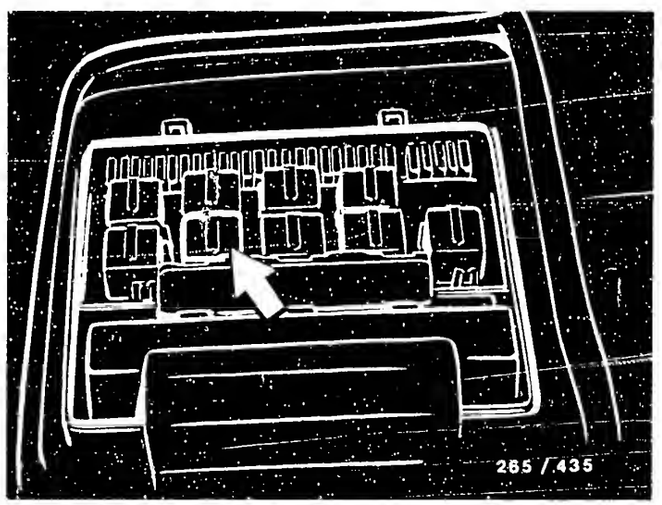
Do not drive with tester connected. Are all test conditions met?

Program-switch positions 1 to 6

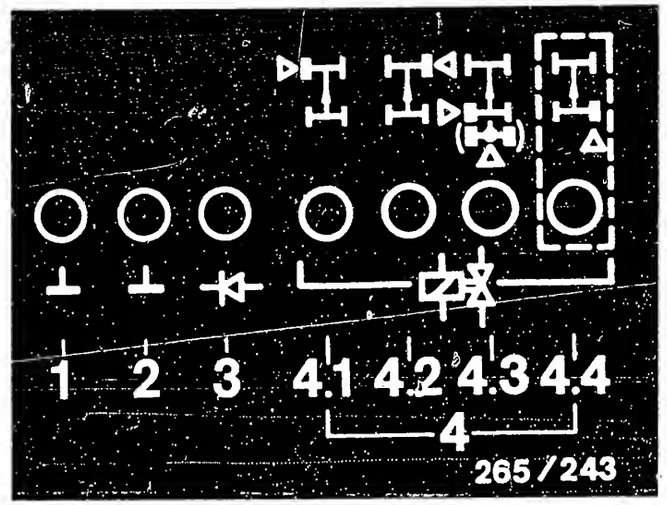
Testing of (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of faults
Power supply (term.1 und term.18)	Ignition on	LED 1 (top picture) continuously lit	*Battery insufficiently charged *High voltage drops *Overvoltage-protection relay defective *Check lead to driving switch term.15



Arrow = Overvoltage-protection relay



RAPID DIAGNOSIS CHART (CONTINUED)

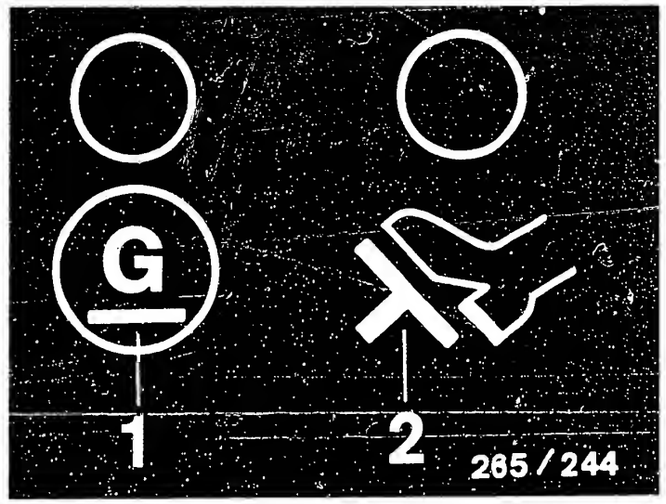


Program-switch position 1 (4-channel hydraulic modulator)

Testing of (measurement at terminals)	Additional operation	Test specification (reading)	Possible causes of faults
Ground connection (term.3, term.36) Diode for warning lamp (term.4, term.6) Solenoid-operated valve internal res. (term.2, term.19, term.21, term.37) Off-position and ground connection of relay ABS warning lamp	Ignition on	7 LED (1 to 4.4) simultaneously brightly lit (top picture) ABS warning lamp in vehicle must light up	* LED 1 and/or 2 (top picture) not lit: Check ground terminals for open circuit. * LED 3 (top picture) not lit: Diode defective, check ground connection of valve relay. * One or more LEDs 4 not lit: Check corresponding plug-in connection for solenoid-operated valve and leads. Solenoid-operated valve internal resistance 0,7...1,7 Ω * All LEDs 4 and LEDs 3 not lit: Check ground connection of valve relay, valve relay defective. * Dimmer lighting-up of an LED means contact resistance in the corresponding circuit. * ABS warning lamp not lit: Warning lamp defective. Note: all other 6 LEDs lit.

RAPID DIAGNOSIS CHART (CONTINUED)

Program switch setting 2

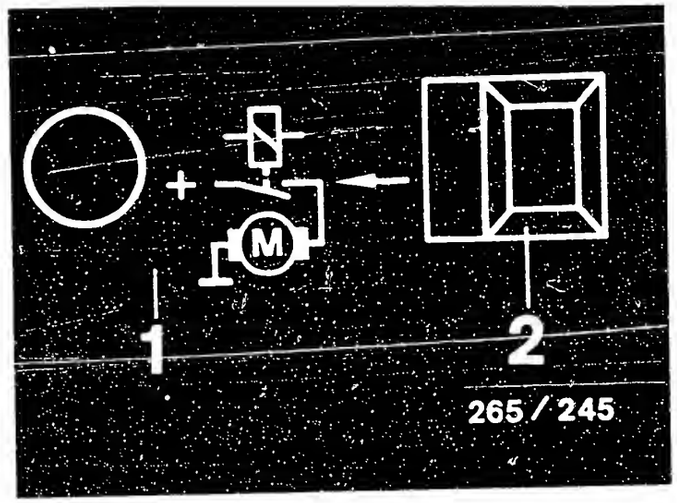


Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Alternator voltage of term.61 (term.33)	Ignition on	LED 1 (top picture) lights up.	* LED sometimes only goes out after accelerating (test is thus O.K.)
	Start engine	LED 1 (top picture) goes out when engine running	* Test lead to alternator term.61 * Alternator defective.
Brake-light switch (term.15)	Ignition on	LED 2 (top picture) lights up	* Brake-light switch defective. * Test lead to brake-light switch.
	Depress brake pedal	LED 2 (top picture) goes out	* Lead incorrectly connected to brake-light switch.

RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 3

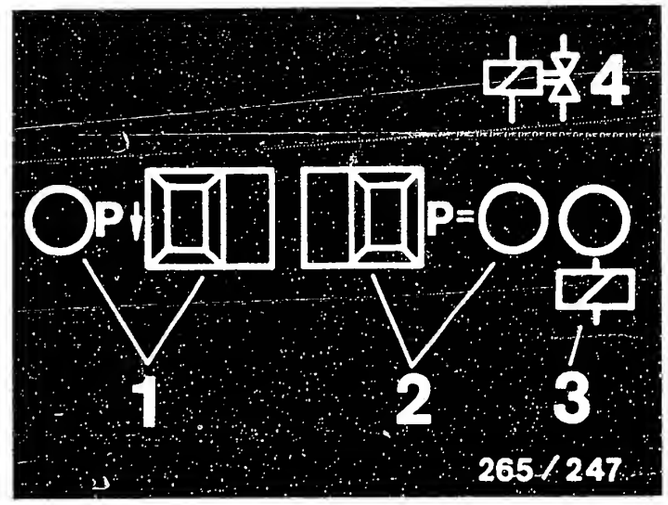
Under test (measurement at the terminals)	Additional operation	Test specifications (reading)	Possible causes of trouble
Motor relay, pump motor in hydraulic modulator (term.5 and term.25)	Ignition on, keep push-button 2 constantly pressed (upper illustration)	LED 1 lights up, pump motor runs. After the push-button has been released, LED stays lit due to running on (dieseling) of the engine (upper illustration).	* Motor relay defective * Check frame connection and positive terminal of pump motor. * Check following leads: from controller term.5 and term.25 to hydraulic modulator term.12 and check term.9. From controller term.20 to hydraulic modulator term.8 . * Pump motor/hydraulic modulator defective.

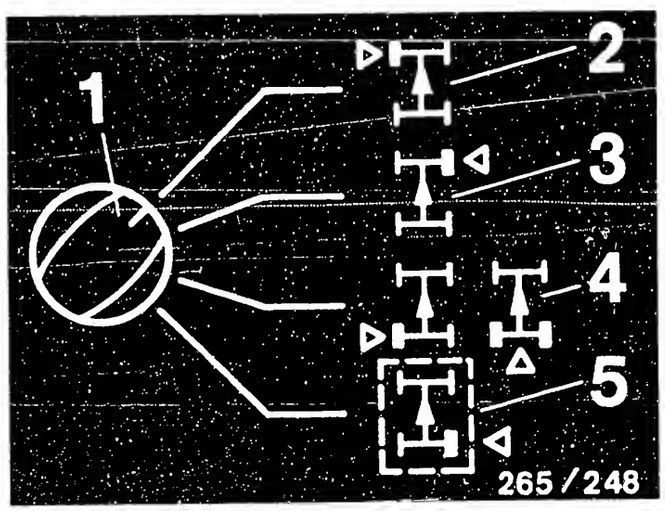


Program-selector-switch position 4 not applicable.

RAPID DIAGNOSIS CHART (CONTINUED)
Program switch setting 5 (4-channel hydraulic modulator)

Testing of (measurement at terminals)	Additional operation	Test specification (indication)	Possible causes of fault
Valve relay function (term. 23)	Ignition on	LED 3 (top picture) lights up	* Valve relay (winding) or leads defective
Check solenoid valves in hydraulic modulator for proper functioning and mix-up. NOTE: Perform test consecutively for each individual wheel. Comply with operating sequence!	Check up vehicle. Ignition on. It must be possible to turn the wheel to be tested freely by hand. Set switch 1 for wheel selection to wheel to be tested (bottom picture).		* Repeat test with engine running * Valve relay (make contact) defective * Open-circuit in lead from valve relay, term. 87 to B+ * Brake lines mixed up at hydraulic modulator
Function Pressure retention	1. Press button P= (top picture) constantly	LED P= (top picture) lights up	* Current value is not attained (LED P arrow or P= off; top picture): Insufficient battery charge. Repeat test with engine running.
	2. Constantly depress brake pedal	Wheel can be turned by hand	
	3. Release button P= (top picture)	LED P= goes out (top picture) Wheel locks	
Function Pressure reduction	4. Press button P arrow (top picture)	LED P arrow (top picture) lights up, wheel can be turned by hand	* Proper electrical connection of solenoid valves? Front left wheel: term.21 Front right wheel: term.37 Rear left wheel: term.19 Rear right wheel: term. 2 Rear axle: term.-
	5.Release button P arrow (top picture)	LED P arrow (top picture) goes out, wheel locks	* Hydraulic modulator defective
	6.Release brake pedal		

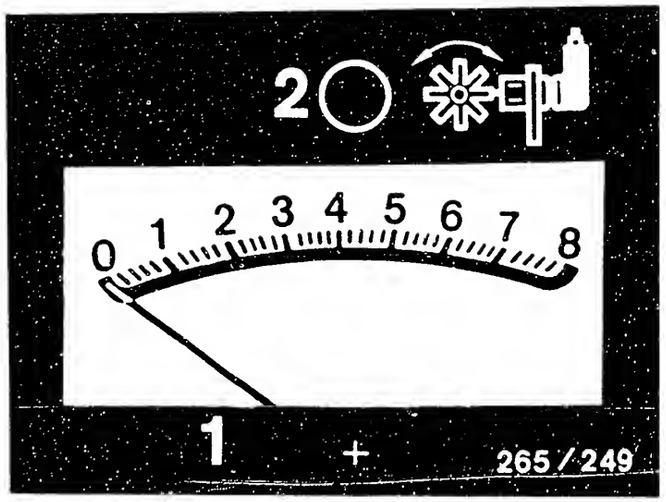


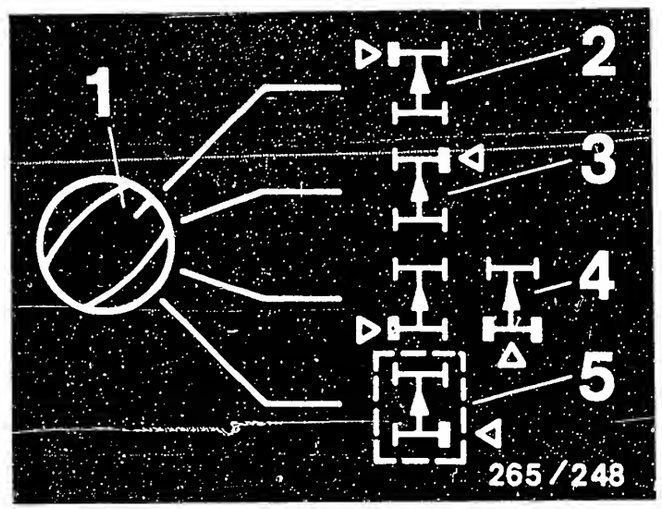


RAPID DIAGNOSIS CHART (CONTINUED)

Program-selector-switch position 6 (4 wheel-speed sensors)

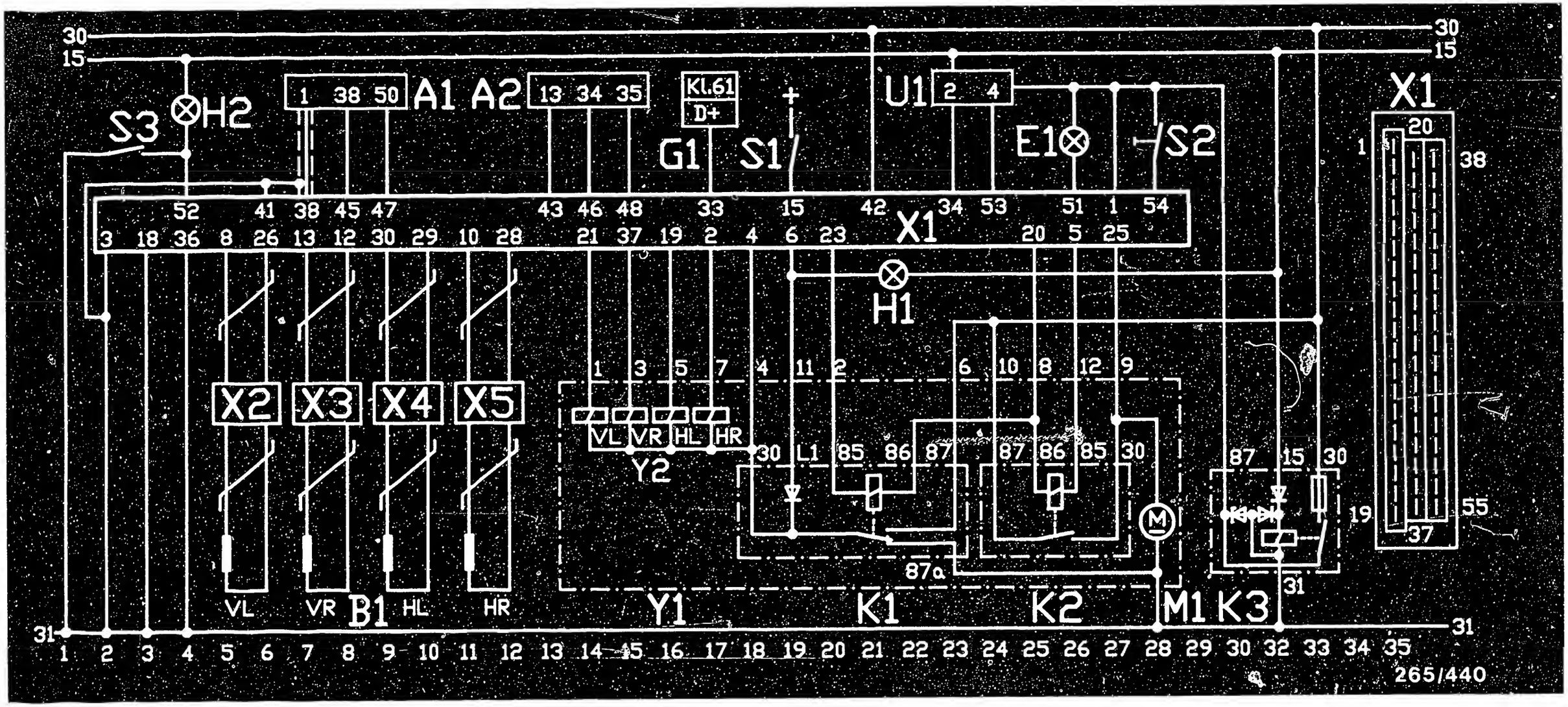
Under test (measurement at the terminals)	Additional operation	Test specification (reading)	Possible causes of trouble
Wheel-speed sensor for operation and mix-up NOTE: Check each wheel separately in turn. (Wheel, front left: term 8 and term.26 Wheel, front right: term.12 and term.13/32 Wheel, rear left: term.29 and term.30 Wheel, rear right: term.10 and term.28)	Chock-up vehicle. Ignition on. The wheel being tested must be freely turnable by hand. When testing the driven axle, the wheel not being tested must be locked. Set switch for wheel selection to wheel to be tested (lower illustration) Turn wheel by hand until LED 2 above instrument lights up without flickering. (Wheel speed approx. 1 revolution per second). Afterwards, read off indication at instrument: (upper illustration)	1. Smallest reading larger 1.6 <u>divisions</u> 2. Permissible fluctuation max. 25 % of largest reading.	*Wheel-speed-sensor lead mixed up *Brake in wheel-speed-sensor lead *Wheel-speed sensor defectove Winding resistance Front axle: 0,6...1,6 k Ω Rear axle: 0,6...1,6 k Ω *Air gap between wheel-speed sensor and ring gear too wide *Ring gear defective or loose *Ring gear with incorrect number of teeth installed Front axle: 48 teeth Rear axle: 48 teeth *Wheel-bearing clearance too large *Instrument gives reading, LED 2 does not light up: loose contact in wheel-speed sensor lead.





Wheel-speed sensor		
* Winding resistance at ambient temperature (-10°C...+120°C) for		
Front axle:	600...1600	Ω
Rear axle:	600...1600	Ω
Hydraulic-modulator solenoid-operated valves		
* Winding resistance at ambient temperature (-10°C...+120°C):	0,7...1,7	Ω
Air gap:	0,8±0,5	mm
Tightening torque for		
* Fastening screws of wheel-speed sensors:	> 8	Nm
* Brake-line connections on hydraulic modulator:	12...16	Nm
Number of teeth		
* Front axle:	48 teeth	
* Rear axle:	48 teeth	

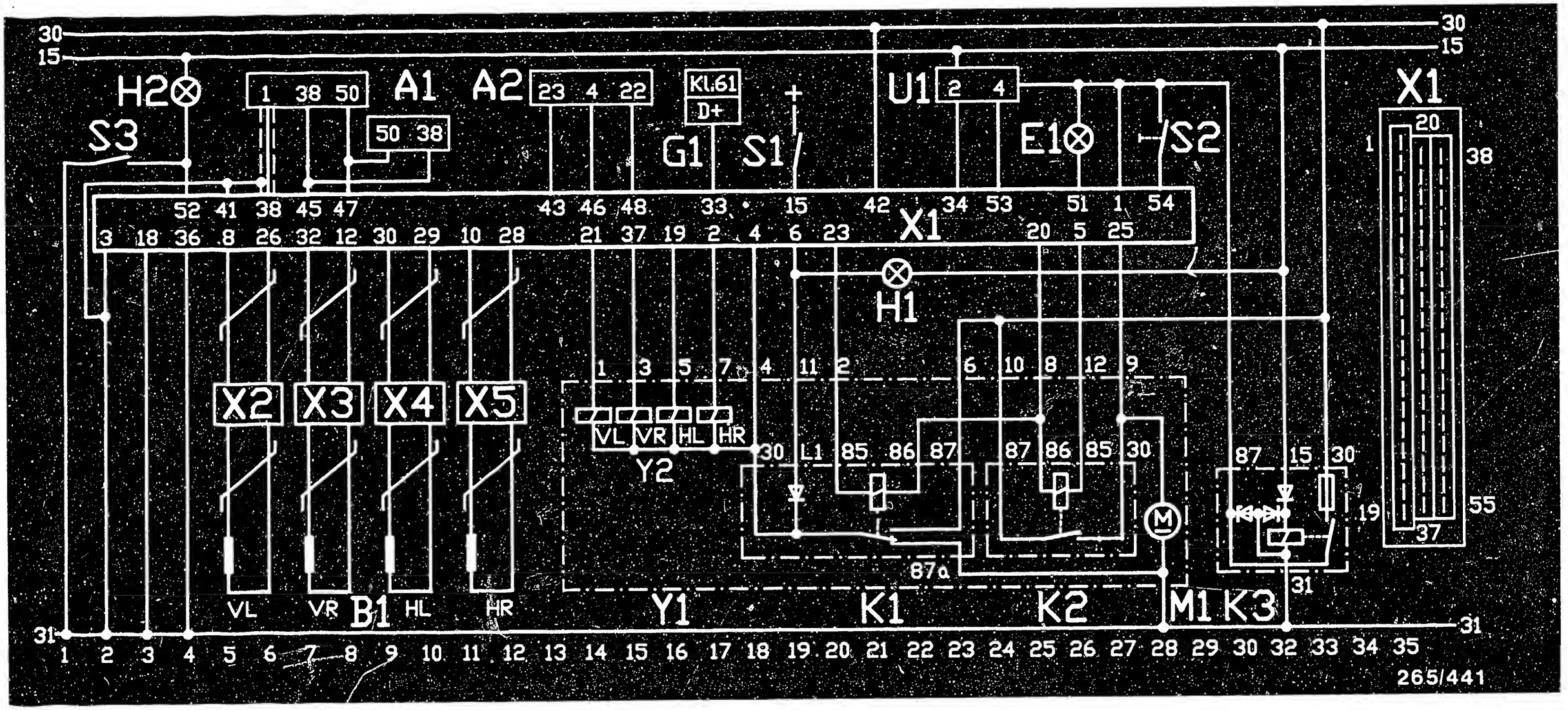
For production reasons: continued on the following coordinate.



A1 = Motronic control unit
A2 = Electronic-accelerator control unit
B1 = Speed sensor
E1 = ASR indicator lamp
G1 = To alternator term. 61/D+
H1 = ABS warning lamp
H2 = Handbrake indicator lamp
K1 = Valve relay
K2 = Motor relay
K3 = Overvoltage-protection relay
M1 = Pump motor
S1 = Stop-lamp switch
S2 = ASR switch
S3 = Handbrake switch
U1 = Check control (blue plug)
X1 = ABS/ASR controller plug
X2,X3,X4,X5 = Speed-sensor plug
Y1 = Hydraulic modulator
Y2 = Solenoid-operated valves
HL,HR = rear left/right
VL,VR = front left/right
1 = for controller with blue nameplate

ELECTRICAL TERMINAL DIAGRAM BMW 7351, 8.87->

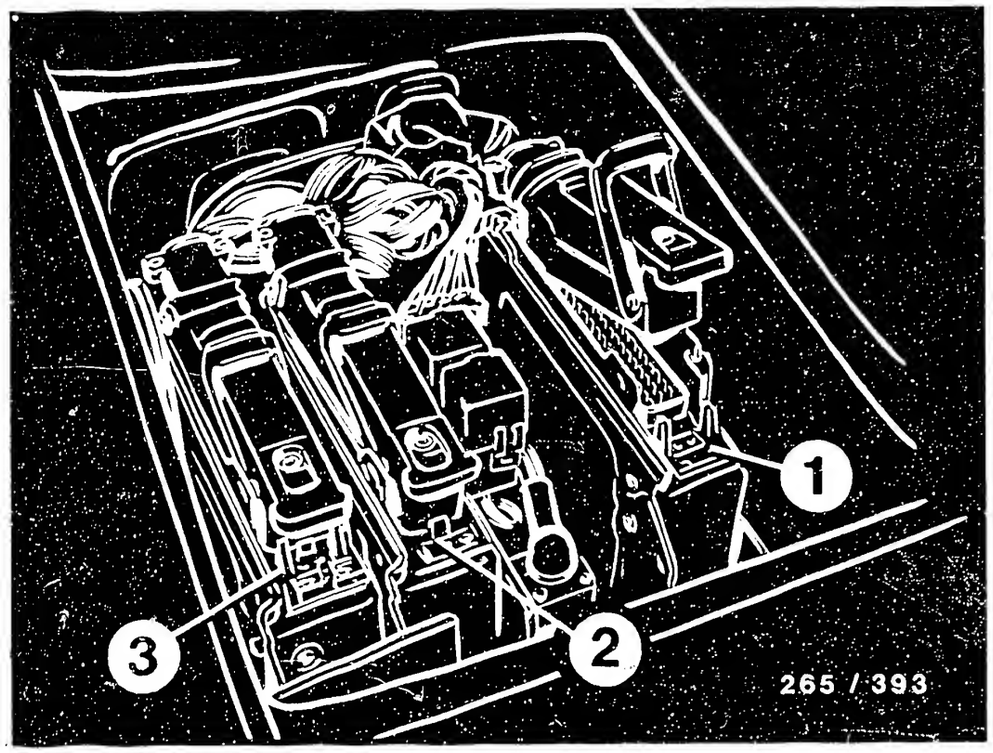
M19 — ==> M20 — <==>



A1 = Motronic control units
A2 = E Gas control unit
B1 = Wheel-speed sensor
E1 = ASR repeater lamp
G1 = To alternator term. 61/D+
H1 = ABS warning lamp
H2 = Hand-brake indicator lamp
K1 = Valve relay
K2 = Motor relay
K3 = Overvoltage-protection relay
M1 = Pump motor

S1 = Stop-lamp switch
S2 = ASR nonlocking switch
S3 = Hand-brake switch
U1 = Check Control (blue plug)
X1 = ABS/ASR controller plug
X2,X3,X4,X5 = Wheel-speed sensor plugs
Y1 = Hydraulic modulator
Y2 = Solenoid-operated valves
HL,HR = Rear left, rear right
VL,VR = Front left, front right

ELECTRICAL TERMINAL DIAGRAM BMW 7501(L) 09.87->



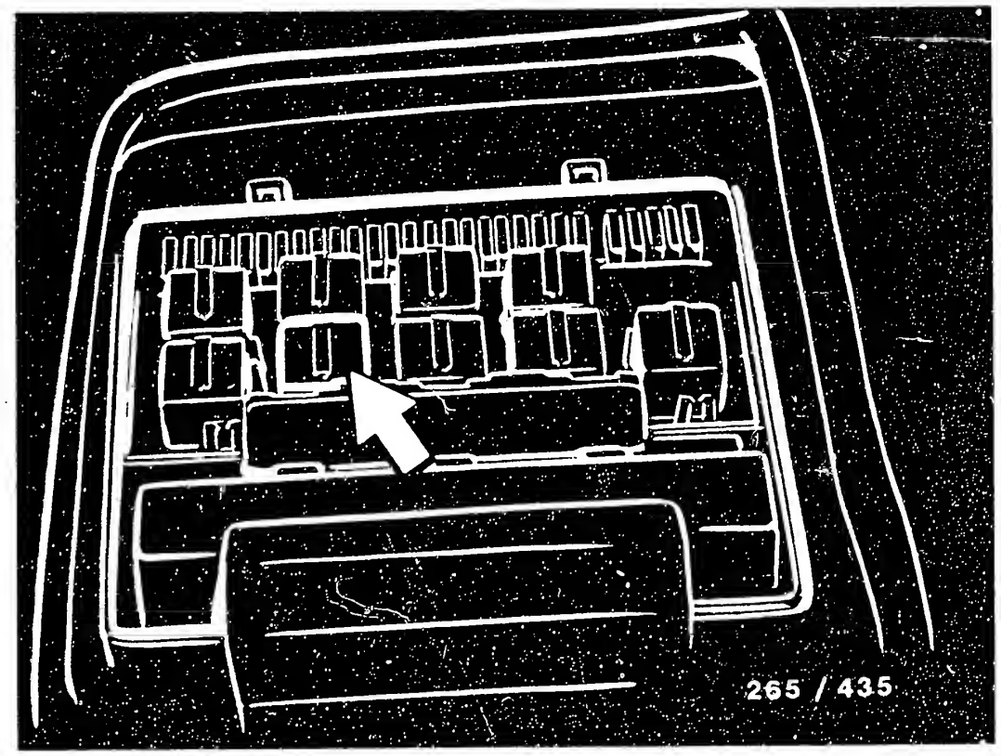
1 = ABS/ASR controller
2 = E Gas control unit
3 = Motronic control unit in 735i.

INSTALLATION POSITION OF COMPONENTS

* ABS/ASR controller (Item 1):
  In the engine compartment beneath the engine hood.
  Remove cover.
  Pull off plug:
  Lift up unlatching clip and unhook plug on wiring-harness end from mechanical encoder.

* ABS warning lamp:
  In the instrument cluster.
  Labelled: ABS.

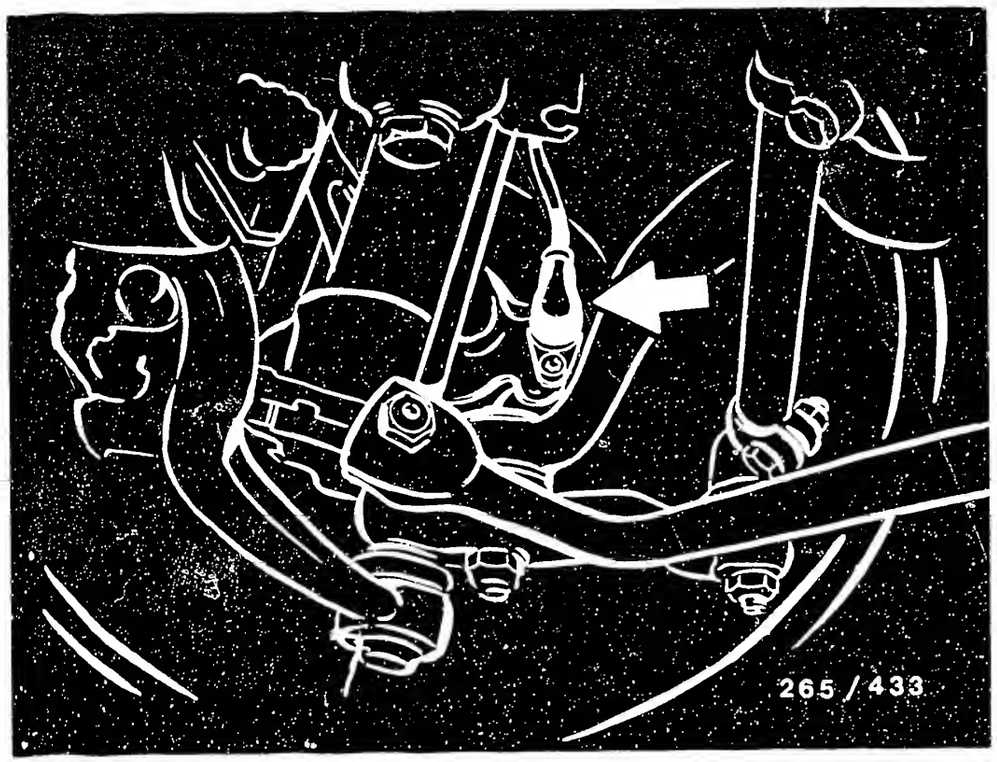
* Ground terminal:
  In the engine compartment on the control-unit box on the left beneath a cover.



1 = Overvoltage-protection relay

INSTALLATION POSITION OF COMPONENTS (Continued)

Overvoltage-protection relay:
In the fuse and relay box. Relay box in the engine compartment on the left-hand side in front of the firewall.



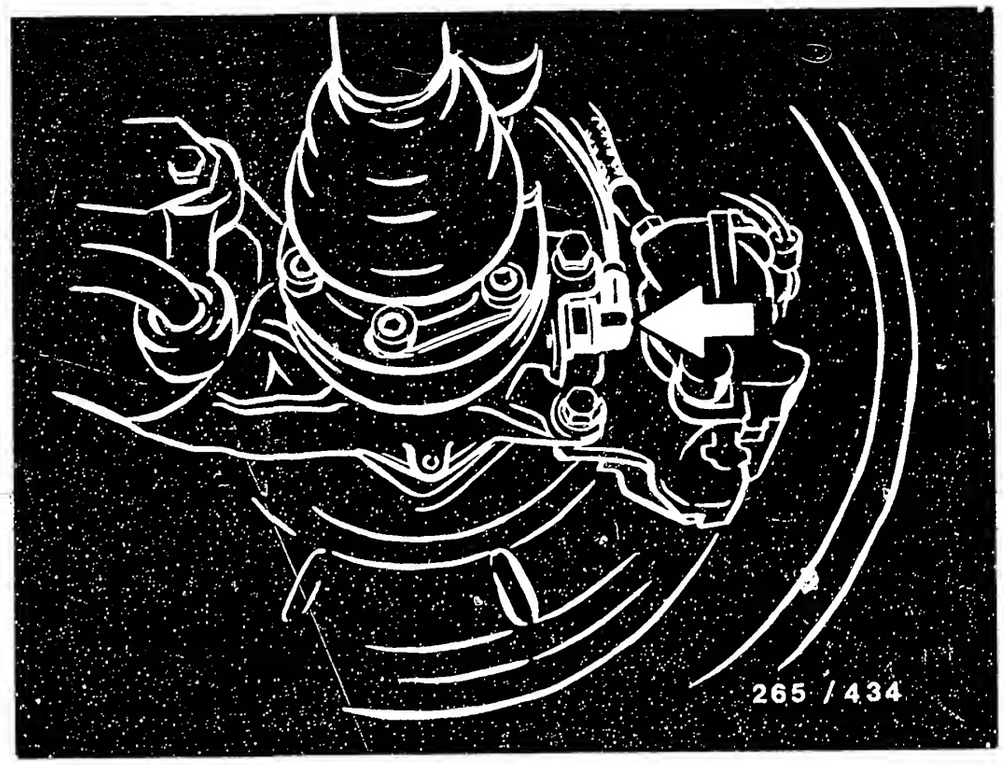
Arrow = Engine-speed sensors, front

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Hydraulic modulator:
  730i, 735i:
  In the engine compartment on the left-hand side in front of the brake master cylinder.
  750i (L):
  In the engine compartment behind the left-hand headlamp.
  The hydraulic modulator must not be repaired, but must be exchanged only as a complete unit.
  Exception: The relays may be exchanged.

  Make sure that the brake-line connections are not mixed up.

* Wheel-speed sensors, front axle:
  One on each side in the steering knuckles.
  Wheel-speed-sensor plug-in connections:
  In the engine compartment in the left and right wheel houses.



Arrow = Wheel-speed sensors, rear

INSTALLATION POSITION OF COMPONENTS (CONTINUED)

* Wheel-speed sensors, rear axle:
  One on each side in the rear-axle trailing arm.
  To exchange, remove a wheel and loosen brake caliper.

  Wheel-speed-sensor plug-in connections::

  Behind the leadthroughs in the floor panel; that is, on the left and right beneath the rear seat bench.